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NEUROPTEROID INSECTS FROM FORMOSA

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THREE PLATES

In 1934 Mr. J. Linsley Grossitt collected a fair number of neuropteroid insects on Formosa. Dr. R. Takahashi has sent me for study his collection of Formosan Psocidæ. These collections form the basis of the following account.

Few collections of these insects have been made on the island. Over twenty years ago Sauter collected insects in the southern part of the island. His material in this group was reported upon by Klapalek, Enderlein, and Petersen. Okamoto and Nakahara have described several species in their papers on these insects of the Japanese Empire. Later Issiki published a large paper on the Panorpidæ.

It is at once noticeable that with these insects, as with others, the island shows great affinity to the Asiatic mainland, particularly the highlands. There are, it is true, a few species widely spread in the Malay region and even to the Philippines, but, as a rule, the species and many genera are different from those of the Philippines. The numerous Panorpidæ, the large sialids, and the *Raphidia* species, as well as the bulk of the Perlidæ, are entirely foreign to the Philippines.

To Japan proper there is much more affinity, although the island is three times as far from Japan as it is from the Philippines. Most of the genera and a number of the species are the same as those of Japan, fully as great a proportion as in adjacent China.

I have included a few species taken in the Loochoo Islands, northeast of Formosa.

A set of the Psocidæ has been returned to Dr. R. Takahashi; the rest of the material is in the Museum of Comparative Zoölogy.

PSOCIDÆ

Genus ISOPHANES novum

Wings of the texture and appearance of *Calopsocus*, being concave and the tip bent down; the surface of the forewing is roughened in only a few places and then less strongly than in *Calopsocus*. The forewing has the long discoidal cell as in that genus, but the cubitus has not the long fork and there is no trace of the irregular venation characteristic of *Calopsocus*. There are but three branches of medius beyond the cell (four in *Psocus*); the stigma is like some species of *Psocus*, strongly angulate behind, and in one species (*P. palliatus* Hagen) there is a very distinct process to the angle; in the hind wing the medius is not forked.

Type of the genus, *I. decipiens* sp. nov.

I include also *Psocus palliatus* Hagen. The genus is an offshoot of *Calopsocus*, differing principally in the more regular venation.

ISOPHANES DECIPIENS sp. nov.

Head reddish, labrum brown, nasus darkened, as also the vertex, in alcohol the head is pale yellow; vertex almost as sharp as in *Calopsocus*, distinctly bilobed; antennæ pale on base, black beyond (in alcohol pale), moderately hairy. Thorax above yellowish, pleura darkened; legs pale, tips of tibiæ and tarsi dark, hind femora dark, abdomen pale. Head structure as in *Calopsocus infelix*. Forewing with short hairs on veins as in *Calopsocus*, those on basal costal edge also short. Membrane fairly shining and wholly dark brown; hind wing fumose, with darker veins.

Venation as figured, discal cell long, no fork to cubitus, no trace of irregular venation, stigma strongly angulate behind, but no process. Condition of medius and radial sector at the connection variable, sometimes just touching at one point, sometimes united for a very short distance, and in one specimen with a very short crossvein.

Length, 4 to 4.5 mm.

FORMOSA, Hassenzan, June 26; Sakaheu, July 13; Bukai, June 13 and 14; Urai, May 1 (*Gressitt*); Taihoku, May 14 (*Takahashi*). Type, M. C. Z. No. 21757; paratype in Takahashi collection.

Isophanes palliatus Hagen (*Psocus*) is a smaller species, with darker head and thorax and pale antennæ, the stigma has a very distinct process from the angle behind.

PSOCUS TOKYOENSIS Enderlein.

FORMOSA, Rokki, May 13 to 26; Chipon, April 18; Musha, May 20; Taihoku, May 22 and July 17; Hassenzan, June 23 to 27; Kuraru, April 11, May 4, and June 3 to 9. LOOCHOO ISLANDS, Iriomote Island, July 1 (*Gressitt and Takahashi*).

Psocus capitatus Okam. is but a variation of this species.

PSOCUS FORMOSANUS Okamoto.

FORMOSA, Kuraru, June 3 to 9; Hori, July 5 to 9; Musha, May 20; Hassenzan, June 27 (*Gressitt*).

PSOCUS SEXPUNCTATUS Linnæus.

FORMOSA, Hori, July 6 to 9; Musha, May 21; Suisha, June 1 (*Gressitt*).

PSOCUS FILICORNIS Enderlein.

I identify four females from Rokki, May 13 to 26; Kuraru, May 7; Kanshrei, April 18; and Arisan, July 5 (*Gressitt and Takahashi*), as probably this species described from Singapore and based on males. These specimens are closely related to *P. longicornis;* one specimen has about the basal one-tenth of wing black, the others scarcely show it (in males the basal fifth is black); otherwise the wing is clear except the black stigma. In all four the areola postica is very narrow above, almost pointed; Enderlein does not mention this; the European *P. longicornis* has a broad top to areola postica.

PSOCUS OBSITUS Enderlein.

Hassenzan, June 26; Hori, July 8 and 9 (*Gressitt*).

PSOCUS SAUTERI Enderlein.

Hassenzan, June 22 to 27; Bukai, June 14 (*Gressitt*).

AMPHIGERONTIA JEZOENSIS Okamoto.

FORMOSA, Kanshrei, April 19. LOOCHOO ISLANDS, Iriomote Island, July 1 (*Gressitt and Takahashi*).

SIGMATONEURA SINGULARIS Okamoto.

Kuraru, June 3 to 9; Shonoryo, June 11; Shirin, October 11 (*Gressitt and Takahashi*).

COPOSTIGMA HYALINA Okamoto.

Kuraru, May 8 (*Gressitt*).

TÆNIOSTIGMA INGENS Enderlein.

FORMOSA, Hassenzan, June 23 to 27; Arisan, July 5; Kanshirei, April 18; Kuraru, June 3 to 9; Suisha, June 2; Shonoryo, June 11; Taihoku, June 29. CHINA, Foochow, August 3 (*Gressitt and Takahashi*).

KODEMAIUS BREVICORNIS Okamoto.

Taihoku, March 27 to April 25; Taiheizan, May 8; Kuraru, May 5; Mareppa, August 10; Hassenzan, June 27 (*Gressitt and Takahashi*).

The female is much larger and darker than the male, with eyes wide apart, but still very prominent.

LOPHOPTERYGELLA CAMELINA Enderlein.

Taihoku, May 22 and July 18; Kagi, April 24; Keelung, July 31 (*Takahashi*).

Genus STENOPSOCUS Hagen

Of the four species of this genus, one agrees with the common Japanese form and the others are new with a more angulate stigma than that in the Japanese species. The venation is about the same, with frequent variations in length of forks, and in one case with an extra fork to the radial sector.

Key to the species of Stenopsocus.

1. Head pale, with a medium black stripe from vertex through ocelli and over nasus, clypeus somewhat darkened, femora yellowish, in males the tibia nearly black, stigma slender, dark behind, not as wide as length of the crossvein; basal joint of antennæ pale..... *aphidiformis.*
   Head largely black, with more or less evident pale spot in middle of vertex; clypeus pale ..... 2.
2. Pterostigma yellow, bordered with black only on the outer part of hind margin, legs wholly pale; basal joint of antennæ partly pale. *externus.*
   Pterostigma marked with dark all along the hind margin; basal joint of antennæ black ..... 3.
3. Hind tibiæ black in both sexes; stigma plainly angulate behind; thorax scarcely pale in the middle..... *tibialis.*
   Hind tibiæ pale (as rest of legs); stigma but little angulate behind; thorax pale in middle..... *formosanus.*

STENOPSOCUS APHIDIFORMIS Enderlein.

Bukai, June 13 and 14; Rokki, May 13 to 26; Hassenzan, June 22 to 27; Musha, May 20 and 21; Arisan, June 5 and 7; Sakuhen, June 16 (*Gressitt*).

STENOPSOCUS FORMOSANUS sp. nov.

Head black, shining, a large transverse yellowish or whitish spot on vertex, clypeus very pale; antennæ wholly black; thoracic notum black, with a pale median stripe between black lateral lobes; pleura black; abdomen dark on base, beyond pale as also venter, tip black; legs pale, knees darker as also tips of hind tibiæ and tips of all tarsi. Wings hyaline, venation brownish, radius brown to deep black, in several females a large, elongate, dark spot over origin of radial sector; stigma yellow, its hind margin bordered with black along entire length and extending down on crossvein, stigma here scarcely as wide as length of crossvein, and crossvein about as near to tip as to base and scarcely oblique; angulation of stigma fairly prominent.

Length to tip of wing, 5.5 to 6 mm.

FORMOSA, Hasenzan, June 22, 25, and 26; Arisan, May 27 and June 6 (*Gressitt*). Type, M. C. Z. No. 21760.

STENOPSOCUS TUHALIS sp. nov.

Head black, clypeus very pale, pale median spot on vertex not so very distinct; antennæ wholly deep black; thoracic notum black; a median rather yellowish area, pleura black; abdomen dark at tip; legs largely pale, but hind tibiæ wholly black. Wings hyaline, veins rather pale, radius brown, sometimes slightly margined; stigma yellow, its posterior margin bordered with deep brown and extending down on crossvein, stigma plainly angulate at crossvein and here as broad as length of crossvein, crossvein at about middle of length and slightly oblique.

Length to tip of wing, 5.5 to 6 mm.

FORMOSA, Arisan, May 24 and 29; June 2 and 7; Taihoizan, May 8 (*Gressitt*); Arizan, April 22 (*Takahashi*). Type, M. C. Z. No. 21759; paratype in Takahashi collection.

STENOPSOCUS EXTERNUS sp. nov.

Head black, shining, a large transverse pale spot on vertex, clypeus pale; antennæ deep black, basal joint partly pale, especially below, thorax black, a small, faint, pale, median area; pleura mostly dark; abdomen pale, dark at tip; legs pale, tips of tarsi darker. Wings hyaline, veins pale, radius brownish; stigma clear yellow, its posterior external edge broadly bordered with deep black as far as crossvein; stigma angulate behind at crossvein and here plainly broader than the length of the crossvein, this crossvein nearer to base of stigma than to apex, and scarcely oblique.

Length to tip of wings, 5 mm.

FORMOSA, Taihoku, May 6; Arisan, May 29 (*Gressitt*) and April 19 (*Takahashi*). Type, M. C. Z. No. 21758; paratype in Takahashi collection.

MATSUMURAIELLA ENDERLEINI sp. nov.

This is very close to *M. radiopicta* Endl. and perhaps is but a subspecies or race of it.

Both of my Japanese specimens agree with Enderlein's figure in having the branches of the radial sector widely divergent at the tips, so that the space is wider than that from the first branch to the stigma or from the second branch to the medius. In the four Formosa specimens the branches of the radial sector are much more parallel, so that the space between them at the tip is hardly as wide as that from the first branch to the stigma or from the second to the medius; in fact the radial sector and the medius lie rather nearer together, in one wing the lower branch of the radial sector touching the medius.

The principal difference, however, is that the hair on the head and thorax is about twice as long as in the Japanese specimens, and very dense, white on the head, black on the thorax; the wings are also more hairy and with longer hairs on the base.

The venation in both forms is variable as to the areola postica; in one Japanese specimen it just fails to reach the medius, and in some Formosa specimens barely reaches it; in none is it as long as in Enderlein's figure.

Length of forewing, 4.5 to 5 mm.

FORMOSA, Hori, May 25; Taiheizan, July 3; Arisan, June 4; Hassenzan, June 26 (*Gressitt*); Taichu, April 18 (*Takahashi*). Type, M. C. Z. No. 21756; paratype in Takahashi collection.

ORMIPSOCUS CHLOROTICUS Navás.

Taihoku, June 4 (*Takahashi*).

ANTRIPSOCUS FORMOSANUS Okamoto.

FORMOSA, Chirifu, May 18; Sakahen, June 16 and July 13; Bukai, June 11 to 14; Hassenzan, June 22 to 27; Arisan, May 23 and 26; Suisha, June 2; Taiheizan, July 7 (*Gressitt*). CHINA, Foochow, August 3 (*Gressitt*). Very common. The male has the stigma almost wholly bright reddish, and a dark band from eye to eye. In two males from Arisan the areola postica is longer than high; in one wing of one specimen it is connected by a crossvein to the medius.

PSYPSOCUS TAPPANENSIS Okamoto.

Urai, April 2; Shinten, April 2; Hakumo, November 1; Suisha, May 31 and June 1; Hassenzan, June 20 to 27 (*Gressitt and Takahashi*).

SOLDEA SERIALIS sp. nov.

Head pale, mottled with brown, five oblique brown lines each side between antennæ, ocelli on black spots, a brown spot in middle of the vertex and several smaller brown spots on each side; some erect long hairs on vertex; antennæ pale, slightly marked with brown, with rather sparse but very long hair.

Thorax dark, with small pale spots and lines; abdomen dark at base and at tip; legs pale, tibiæ with two dark bands.

Forewings hyaline, radius, medius, cubitus, and second anal to about middle of wing pale with dark spots, other veins dark; a dark spot at tip of each outer vein, base and apex as well as hind margin of stigma broadly dark, white in the middle, a faint dark cloud behind angle of stigma, and also in fork of radial sector and medius; a series of seven small brown spots subapically, one in each of the apical cells to and including the areola postica; hind wings pale, veins brown.

Stigma very large and strongly angulate behind, areola postica also very large, but a little longer than high.

Length, 3 mm.

FORMOSA, Chirifu, May 19 (*Gressitt*). Type, M. C. Z. No. 21762.

SOLDEA FUSCONERVOSA Enderlein.

Hassenzan, June 21 to 27; Musha, May 21; Hori, June 8 and 19; Sakahen, June 16 and July 13.

Enderlein says thorax "rostgelb," Okamoto, "rostgelblich." I have one discolored specimen which is so, but all the many others have three large black spots on the thorax; the one on anterior lobe is often divided by a narrow pale line; the principal veins are dark, sometimes very dark.

CAECILIUS ABIDUS Hagen.

Taihoku, December 15, on bamboo; Suisha, June 2; Karenko, August 22; Arisan, May 24; Hassenzan, June 22 to 27.

CAECILIUS PODACROBELAS Enderlein.

Taiheizan, May 8; Shikayan, May 12; Pianan, May 11; Arisan, May 24 and July 5; Taihoku, April 23 (*Gressitt and Takahashi*).

In one specimen one wing has a crossvein from areola postica to the medius.

CÆCILICS OKAMOTOI nom. nov.

This is the *C. annulicornis* of Okamoto, which is preoccupied by Enderlein's name.

Riran, April 19 (*Gressitt*).

CÆCILIUS STIGMATUS Okamoto.

Bukai, June 13 and 14; Arisan, May 29, June 4 to 7; Hassenzan, June 22 to 27 (*Gressitt*). This small, dark-winged species has a pale area behind stigma, a white spot at base of areola postica, a white dot at nodus, and a whitish patch at base of stigma.

CÆCILIUS JAPANUS Enderlein.

Taiheizan, May 7; Kuraru, April 7; Bukai, June 13 and 14; Taihoku, December 18 (*Gressitt and Takahashi*).

CÆCILIUS FLAVICORSALIS Okamoto.

Toran, May 23; Shinten, April 13 (*Gressitt and Takahashi*).

CÆCILIUS COMOSTIGMA Enderlein.

Urai, May 1; Taihoku, March (*Gressitt and Takahashi*).

CÆCILIUS FRATERNUS sp. nov.

Head yellowish brown, nasus and labrum dark, both rather brassy, clothed with erect pale hairs; palpi and antennæ pale, latter with only moderately long hairs; thorax black, with short erect hair; abdomen pale brown, darker at tip; legs pale, unmarked. Forewing almost wholly brown, markings very similar to those of the figure of *C. himalayanus* Endl. Base of areola postica pale as in that species, very dark oblique mark on stigma reaching back, clear space behind stigma including the outer radial cell; wing darkest near middle of costal area and along outer margin as in *C. himalayanus*, but it differs in that the entire basal part of the stigma is snow white; the venation is the same, except that the cubitus is plainly a little sinous. The stigma is angulate behind. Hind wings very faintly infuscate, tips scarcely darker.

Length, 4 mm.

FORMOSA, Hori, July 5 to 9 (*Gressitt*). Type, M. C. Z. No. 21767.

CÆCILIUS MUCCENDURCI Enderlein.

Kuraru, May 5, June 3 to 9; Arisan, May 26; Taiheizan, July 7; Hassenzan, June 22. A widely distributed species.

CECILIUS DOLOBRATUS Hagen.

FORMOSA, Hori, June 9; Musha, May 20; Taihoku, March 14. LOOCHOO ISLANDS, Iriomote Island, July 19 and 25 (*Gressitt and Takahashi*).

Described by Hagen from Ceylon, also occurs in Singapore. Of the form of *C. muggenburgi*, it has two dark lines extending in front of the dark streak; one of these crosses the yellow stigma, the other borders the upper branch of the radial sector; the dark streak on outer part of wing reaches to the hind border, in middle of hind margin a wide hyaline area, but the base is largely dark; the hind wing is fumose except the outer costal part which is hyaline. The stigma is elongate, more swollen behind than in *muggenburgi*, but not angulate, the areola postica is short and quite high, larger than in *muggenburgi*. Enderlein puts it in a new genus, *Coryphasmila*

CECILIUS CONFUSUS sp. nov.

Head and thorax largely deep jet black, antennæ pale on base, beyond black; abdomen brownish; legs very pale, almost white, very slender. Forewings hyaline with a brown streak through to tip, at tip breaking up into three parts, one along each branch of radial sector, and a broader one over medius and its upper branch, hinder half of median cells clear to base of areola postica, from here the brown connects to the middle streak; basally the brown not as dark; cubitus and radial sector darkest; upper branch of radial sector curves up more than in allied forms, becoming almost transverse; stigma scarcely yellowish, moderately swollen behind, more so than in *C. muggenburgi*, but not at all angulate behind; space between medius and radial sector about as wide as in *C. muggenburgi*, areola postica larger than in that species. Hind wings fumose, with the outer costal area clear as in *C. dolobratus*.

Length, 4 mm.

FORMOSA, Arisan, May 24 and June 4 (*Gressitt*). Type, M C. Z. No. 21768.

Differs from *tenuicornis* Karny in having radial sector and medius united for a longer distance and in lower areola postica.

CECILIUS SIMILARIS sp. nov.

Resembles *C. dolobratus* and *C. muggenburgi* in having a dark streak through middle of wing. It differs from *muggenburgi* in having a stigma angularly widened behind and with a dark spot to the streak, and first the branch of the radial sector bordered with dark, the outer hind border of the stigma is

sometimes dark. The dark streak is not straight, but in basal half of wing is nearer to costa, and at the connections it bends down and runs out to the tip of the wing from the median vein up to above the radial sector, leaving the apical part of the outer radial cell clear; all the space behind medius is likewise clear, and the medial cell is mostly clear or nearly so, but the cubitus and the base of the radial sector are black-bordered.

Hind wings with surface fumose, except outer costal area, just as in *dolobratus*. First branch of radial sector very oblique and parallel to outer border of stigma. Areola postica (which is clear) of moderate size, plainly longer than high, but reaching more than one-half way to medius. Medius and radial sector, when separating, leave a very broad space, especially near base, very much broader than in *dolobratus*, in which these two veins are rather close together.

Length, 4.5 mm.

FORMOSA, Arisan, May 24 and June 7; Taiheizan, July 7 (*Gressitt*). Type, M. C. Z. No. 21769.

This species is near to the European *C. fuscopterus*, but in that species the dark streak extends farther behind and occupies all of discoidal cell and most of the basal part of wing; the mark at the angle of the stigma is not so dark, and the medius and the radial sector lie closer together than in that species.

These four allied species of *Caecilius*, each with a longitudinal dark stripe through the wing, can be tabulated as follows:

Key to four species of Caecilius.

1. Median cells practically entirely dark; a dark mark from the dark streak up across the yellow stigma, latter swollen but hardly angulate behind; first branch of radial sector bordered with dark ... *dolobratus*.
Outer median cells largely clear; no dark mark reaching across stigma. 2.
2. First branch of radial sector not bordered; no mark from dark streak towards stigma, latter elongate and very low, scarcely swollen behind. *muggenburgi*.
First branch of radial sector bordered with dark ... 3.
3. Stigma angulate behind, with a very dark spot from the angle to the streak; first branch of radial sector very oblique ... *similaris*.
Stigma rounded behind; no spot from stigma to streak, first branch of radial sector bending up so as to be more transverse, both branches bordered with dark ... *confusus*.

OCHROPSILLA ORNATIPENNIS Enderlein.

Hussenzan, June 22 to 27; Taihoku, April 28 (*Gressitt and Takahashi*).

HEMICÆCILIUS QUADRIMACULATUS Okamoto.

Sunsha, June 2 and 11; Taiheizan, May 21 (*Gressitt and Takahashi*). One of the most beautiful species of Psocidæ.

HEMICÆCILIUS LOBATUS Enderlein.

Hassenzan, June 22 to 27; Taihoku, January 18 (*Gressitt and Takahashi*) In one specimen the hind wing shows a faint infuscation near the tip and between the forks. Enderlein puts this species in his genus *Mesopsocus*.

HEMICÆCILIUS TRANSVERSUS sp. nov.

Head dull yellowish, no definite marks, labrum dark, face with fine white hairs, vertex with long erect bristles; antennæ with scattered long hairs; thorax more brown than head, abdomen also; legs pale. Forewings much marked with brown; a broad crossband covering stigma and areola postica, a large elongate mark over outer half of anal vein, continued basally, a mark in the cell before it, two large spots in area before radial sector, one beyond the sector and before the transverse band, this narrowly connected to spots behind it in the next two cells, apical margin narrowly dark; many of the veins in the pale areas narrowly bordered with brown; hind wings unmarked, veins brown. Stigma elongate and low, wholly rounded behind; areola postica moderately long, above reaching about halfway to the medius; apical forks short and subequal.

Length, 3 mm.

FORMOSA, Taihoku, December 18 (*Takahashi*). Type, M. C. Z. No. 21761; paratype in Takahashi collection.

Differs from *H. nigroguttatus* Karny in broader forewing, areola postica higher, radial sector and medius united for much greater distance diverging more at separation.

MACENTELLA FORMOSANA sp. nov.

Head pale, a transverse brown mark on middle of vertex, often a dark mark each side by eyes, and one in front near the ocelli; head with scattered, long, erect hairs; antennæ pale, basal joint with a dark mark, clothed with quite long, sparse hairs, thoracic notum dark brown, a pale mark each side from base of wing forward, and faint lines between the lobes, upper pleura dark; abdomen pale, legs whitish. Forewings hyaline, costal veins pale, others mostly brown, especially beyond middle of wings; base of radial sector and medius before it joining radial sector plainly margined with brown; stigma white, brown at base and more broadly so near tip; extreme tip pale, a faint brown band

across areola postica, one before end of cubitus, and another basad of ends of anals; hind wings hyaline, veins mostly pale, but base of radial sector and cubitus dark.

In some specimens the radial sector and medius join for a short distance, in others just touch, and in one are connected by a minute crossvein.

Length, 2.5 to 3 mm.

FORMOSA, Taihoku, March, June 7, December 6 and 16; Rokki, May 13 to 26; Urai, May 2; Arisan, May 24; Kosaru, June 5 (*Takahashi and Gressitt*). Type, M. C. Z. No. 21770.

EPIPSOCUS HAGENI sp. nov.

Head whitish, three pale brown spots over ocelli, sometimes a faint brown mark at edge of vertex, back of eye; antennæ pale, basal joint with black dot outside, and the second joint with a black line; thorax pale; abdomen also very pale, with scattered black patches on each side, most numerous near base; legs very pale, tips of tibiæ and tarsi black; legs very long and slender.

Wings hyaline, veins also, but extreme tips of outer veins with a small but distinct brown mark; stigma whitish, no trace of any other marks; hind wing also hyaline and with pale veins, except two at tip are brown.

Venation similar to *E. delicatus* Hagen, and to *E. marginatus* Endl.; but areola postica more elongate and lower than in *marginatus*, stigma also slenderer than in *marginatus*. From *E. delicatus* the venation differs chiefly in that the space between radial sector and medius is much broader close to base, in *delicatus* it widens beyond base.

Length, 6 mm.

Baguio, July 23; Horl, June 8; Ramogan, July 24; Rokki, May 13 to 26 (*Gressitt*); Shinten, April 3 (*Takahashi*). Type, M. C. Z. No. 21766, paratype in Takahashi's collection.

In *E. delicatus* Hagen (*completus* Banks) the forewings have a brown band near the outer margin and spots at the ends of the stigma as in *E. marginatus;* there is also a faint or distinct brown band running obliquely back from the basal end of the stigma often meeting the end of the outer band, and towards the basal third of wing a transverse band. The areola postica in *delicatus* is slender as in *hageni*, much more so than in *marginatus*.

Epipsocus nubilipennis Karny, from Borneo, is practically the same as *delicatus*, but with the marks more extended. In a series from Mount Apo there are some strongly marked, others

only faintly so, but none as broadly marked as *nubilipennis*. *Epipsocus fuscofasciatus* Endl. is *Hagenella zonata* Hagen; Hagen's specimens vary in the connection between radial sector and medius.

ECTOPSOCUS CRYPTOMERIÆ Enderlein.

Taihoku, January 15, May 2, October 5; Hori, July 5 to 9 (*Gressitt and Takahashi*)

PERIPSOCUS QUERCICOLA Enderlein.

Kuraru, April 7, June 3 to 9; Urai, April 1; Sakahen, July 15; Taihoku, April 25 (*Gressitt and Takahashi*).

PERIPSOCUS SINGULARIS sp. nov.

Head red-brown, labrum black, rather densely clothed with short hairs, on basal part hardly longer than width of joint. Thorax black, clothed with appressed, short white hair, a pale stripe from base of wing obliquely forward, pleura mostly dark; abdomen brown, paler beneath; legs pale, tibiæ rather more brownish. Forewings uniform, pale, dull, dirty yellowish brown, veins mostly darker, especially cubitus which is heavier than usual, stigma about like veins; anal margin with many very short hairs; hind wings somewhat paler, veins mostly brown, cubitus also very distinct here.

Forewings with stigma quite long, not prominent behind, only gently rounded, and appearing much as in some species of *Caecilius*.

Length, 4 mm.

FORMOSA, Taihorzan, May 21 (*Gressitt*). Type, M. C. Z. No. 21765.

This species has a stigma much like that of *P. sidneyensis*, of Australia; it is larger, with slenderer wings, and of a more yellowish tinge.

PARAMPHIENTOMUM NIGRICEPS sp. nov.

Nasus and front black up to above middle of eyes, across vertex a broad yellowish white band, faintly divided in the middle; cheeks pale; labrum and palpi pale, no distinct spines on palpi, ocelli in a low triangle, anterior one small, posterior nearly twice as far from eyes as from each other; dark parts with very minute white hairs; antennæ pale on base, brown beyond, moderately hairy, hairs about three to four times the width of joint; thorax brown, with white hairs, abdomen brown. Femora large, mostly dark, tibiæ with a dark band near base and another just beyond middle, basitarsus dark at base, tibia with many

spines, not as stout as in *Stimulopalpis*, teeth on claws very small, scarcely distinct. Forewings rich brown, mottled with white patches, mostly near costal border, and across wing near apical third, a more distinct spot in each apical cell; ends of veins on outer margin black, outer fringe partly brown, partly white; hind wings unmarked, veins brown. Forewing with radius showing just beyond crossvein a distinct bend. Hind wing with subcosta showing from its end a faint connection to radius.

Length, 3 mm.

FORMOSA, Taihoku, May 2 (*Gressitt*). Type, M. C. Z. No. 21763.

LEPTUM ENDERLEINI sp. nov.

Head yellowish brown, with moderately long white hair, vertex margin rather sharp; palpi brown; antennæ pale, moderately hairy; ocelli subequal, in a very broad low triangle, posteriors fully four times as far apart as from eyes. Forewings covered nearly uniformly with black and metallic scales; fringes long, costal one dense and towards tip fully one-fifth wing width, and those on outer part of hind margin nearly one-third wing width. Hind wings hyaline, veins nearly black, fringes black, very long on outer half of costa and outer margin; membrane in apical half of wing hairy.

Venation similar to that in *L. chrysochlora*; pedicel of cubital forks longer, radius and radial sector more widely separate at tips; hind wing slenderer and more pointed.

Length, 3 4 mm.

FORMOSA, Hori, June 6; Hassenzan, June 19 (*Gressitt*); Taihoku, June 4 (*Takahashi*). Type, M. C. Z. No. 21764; paratype in Takahashi collection.

PSOQUILLA MARGINEPUNCTATA Uzel.

Taihoku, September 8 (*Takahashi*), many specimens. Nearly all are of the typical short-winged form of both sexes; among them are four that have much longer forewings and well-developed hind wings. One of these is figured (Plate 2, fig. 14). The marginal spots are retained, but the dark is broken up by two irregular hyaline bands. Several of the veins towards the tip become somewhat irregular and sometimes have short lateral spurs. In the hind wing is a dark spot at the end of the cubitus. The head and other parts are as in the short-winged form, so I think there can be no doubt that they are long-winged forms of the same species.

PERLIDÆ

CERCONYCHIA BRUNNEA Klapálek.

Pianan, May 11; Hassenzan, June 22; and Taiheizan, May 8.

CERCONYCHIA LIVIDA Klapálek.

Urai, May 1 and 2; and Musha, May 18. The *Nogiperla* of Okamoto might be this genus, but his figure shows no radial crossveins; the species would be distinct from either of Klapálek's species.

PELTOPERLA FORMOSANA Klapálek.

Taiheizan, May 9.

KAMIMURIA FORMOSANA Okamoto.

Urai, May 8 and 8.

TOGOPERLA ÆQUALIS sp. nov.

Male.—Above black; abdomen reddish yellow, venter and sternum yellowish; legs pale, tips of femora, upper edge of tibiæ and the tarsi dark; antennæ and palpi brown, former paler on basal part; wings brown, costal area pale yellowish as well as the veins here, other veins dark brown; a large pale spot each side of ocelli.

Female.—More yellowish on head, the large ocellar mark broadened in front, but hardly connected to the anterior spot, the M-mark pale; pronotum more or less pale brown in middle, black on sides, the deflexed sides black only on edge, wings more yellow brown than in the male, but much darker than the yellow costal area; apical segment of abdomen pale.

Ocelli almost as near to eyes as to each other; eyes round, superior boss transverse, nearer to eye than to ocellus; pronotum a little broader than long, a trifle narrowed behind, anterior angles acute, hind angles almost square, median area not well marked, sides moderately rugose.

Forewings with about ten to thirteen costals, three or four subcostals, about seven median, and nine to eleven cubital crossveins; radial sector with two or three branches, the first sometimes from the crossvein; crossvein from radius to radial sector oblique, in hind wing about eight cubital crossveins radial sector with two or three branches. Female with pronotum proportionally broader.

Male with sixth and seventh ventral segments each having a median patch of short, stiff brown hair; fifth dorsal segment a little swollen behind, roughened or spinulose near edge, and with a slight process each side bent downward; appendages

very elongate; with a small lobe at base of each. Abdomen of female ending in a median pointed part and a narrow hook each side; ventral plate swollen out narrowly over next segment and slightly emarginate at tip.

Male, length, 10 to 11 mm; forewing, 13 to 16; female, body, 14 to 15; forewing, 18 to 19.

FORMOSA, Shikayan and Pianan, May 11 and 12. Type, M. C. Z. 20196.

TYLOPYGE SIGNATA n. sp.

Male.—Yellowish, thorax and abdomen more tawny; head with a large median black mark from ocelli to the M-line, a narrower black mark on clypeus, antennæ pale on basal part, dark beyond; palpi dark; pronotum with a broad black median stripe, broader behind, front, sides, and hind margin rather broadly black, thus leaving a large pale spot on each side of pronotum, deflexed sides black; notum somewhat darkened around scutelli; femora mostly yellow above, tip, and tibiæ and tarsi black; a median dark patch of hairs on fifth ventral segment, and between hind coxæ, but neither as large nor with so long hairs as in *T. planidorsa;* setæ pale on base, darker beyond. Wings brown, except yellow costal margins to both pairs, costal veins yellow, others dark brown; in some places the middle of the cells paler brown.

General structure like that of *T. planidorsa*, hind ocelli much smaller than in that species, scarcely larger than anterior ocellus, nearly as far apart as from eyes; superior boss larger than ocellus, oblique, and much nearer to eyes than to ocellus.

Pronotum broader than long, narrowed behind, front angles acute, hind corners rounded; median area moderately broad, rugose on sides, mostly towards middle. Forewings with about ten costals, two or three subcostals, six or seven median, and seven or eight cubital crossveins; radial sector with one branch, and one from the crossvein, lower branch of median forked beyond the crossvein; hind wings with about six cubital crossveins, radial sector with two branches.

Male with both sixth and eighth dorsal segments having a median patch of spinules on apical part of segment.

Length, 11.5 mm; forewing, 15.

FORMOSA, Urai, April 2. Type, M. C. Z. 20193.

Differs from *T. minor* in having costal area yellow, dark palpi, and spinules on the sixth as well as the eighth segment. The appendages are much slenderer than in *T. minor*.

TYLOPTCE PLANIDORSA Kimmins.

Rokki, May 12; and Hassenzan, June 25.

Genus SCHISTOPERLA novum

Two ocelli, far apart, head prolonged back of eyes more than length of eye, eyes rather small; no median furrow on back of head; lateral sutures nearly parallel and reaching back to superior boss, not touching eyes; pronotal side margins not deflexed so that pronotum is angulate on sides. Body rather long; wings moderately long, venation similar to that of *Neoperla*. Male genitalia simple, a hairy boss on ninth ventral, and appendages short, close together, and divergent. Ventral plate of female large.

According to Klapalek this would be an acroneurine because of the male genitalia, according to others a neoperline. The nearly parallel sutures on the metasternum reaching almost to the hind margin and the head structure distinguish it from both groups. Probably related to the American *Kathroperla* and *Paraperla*, all lacking the deflexed sides to pronotum, and with the head extended behind eyes; the American genera, however, differ in metasternal sutures, ocelli, sutures on head, and other details.

SCHISTOPERLA COLLARIS sp. nov.

Black; head dull black, a little reddish each side in front; pronotum black, sides broadly margined with yellow; notum dull black; abdomen brown, setæ scarcely paler; antennæ and palpi brownish; legs dark brown to black; wings dark brown, costal area with the veins here pale yellow, other veins dark brown.

Head broad in front, M-line with the middle part distinct, back of this a transverse impression; from anterior part of eye a line to the superior boss; ocelli at least six diameters apart; superior boss close by side of ocellus, and more than twice as large; surface of head with fine short hair. Pronotum broader than long, sides angulate in middle, median area rather wide, surface each side moderately rugose; abdomen elongate, slender, clothed with fine short hair, setæ short, bristly besides the fine hair.

Male appendages appear as two erect approximate pieces, above diverging and tips rounded; last dorsal segment reddish, with a forked, median black mark, and a black stripe each side, an elevated spot at end of each stripe. Ventral plate of female greatly extended, almost to tip of abdomen, with a distinct median notch.

Forewings with about ten costals, four subcostals, about ten median and nine cubital crossveins; radial sector with two branches beyond and one from crossvein; crossvein from radius to radial sector at right angles; the two branches of anal cell far apart at base; in hind wings six to eight cubital crossveins, radial sector with three branches or with two branches and one from the crossvein.

Length, 14 to 15 mm; forewing, 17 to 18.

FORMOSA, Taiheizan, May 6 and 7. Type, M. C. Z. No. 20190.

NEOPERLA CRUCIGERA Klapálek.

One female, 54 mm, from Rokki, May 15, is probably this species, which was described from a male; the markings on the thorax are not as distinct as described; the ventral plate is truncate, about three times as broad as long. The genus must be near *Acroneuria* as the metasternum shows the same Y-shaped suture.

ANTINA LUCIDA Klapálek.

Hassenzan, June 24.

PUNDOSITA HATAKEYAMAE Okamoto.

Urai, April 30.

Key to the species of Neoperla

1. Pronotum and head with distinct median black marks; venation scarcely paler on costal area ..... 2.
   Pronotum and head scarcely, if at all marked with black; venation distinctly paler on costal area ..... 3.
2. Forewing scarcely 10 mm long ..... *signatella.*
   Forewing fully 18 mm long ..... *klapálekí*
3. Length of forewing about 10 to 12 mm ..... *formosana.*
   Length of forewing about 16 to 18 mm ..... *uniformis.*

NEOPERLA UNIFORMIS sp. nov.

Female.—Yellowish, not very clear, scarcely marked with dull brown. Ocelli on black spots, a brownish cloud over lower part of face; antennæ and palpi also yellowish; pronotum dull yellowish brown, rather darker on sides; abdomen pale throughout, also setæ; legs a little darker on upper edges and tips of tarsi; wings dull gray, costal area and veins there pale yellow, other venation rather dark brown.

Ocelli about two and one-half diameters apart, much farther from eyes; superior boss rounded, nearer to ocellus than to eye; pronotum broader than long, front corners acute, hind corners broadly rounded, middle area rather narrow, sides strongly rugose.

Forewing with about ten to twelve costals, three or four subcostals, about eight median and five cubital crossveins; three branches from radial sector beyond crossvein and usually one from crossvein. In hind wing about five cubital crossveins, two or three branches to radial sector.

Female with ventral plate not projecting, but indicated on margin by a slight median swelling.

Length, 13 mm; forewing, 17 to 18.

FORMOSA, Hassenzan, June 22; Urai, May 3; Funkito, June 8. Type, M. C. Z. No. 20195.

NEOPERLA SIGNATALIS sp. nov.

Female.—Pale yellowish; a prominent square black mark over ocelli and forward to clypeus, a triangular black spot on clypeus; antennæ and palpi yellowish brown; pronotum with a broad, median black stripe and the front and side borders narrowly black, deflexed sides black; notum rather brownish yellow; abdomen similar near tip above; wings gray, veins yellow gray, costals a little paler; legs pale, upper edges darker.

Ocelli small about three diameters apart, only a little farther from eyes, pronotum broader than long, front corners acute, hind corners broadly rounded. Forewing with seven or eight costals, two or three subcostals, about six in both median and cubital series; radial sector with two branches; radial cell much shorter than radius to base. Hind wing with about six cubital crossveins, radial sector with two branches. Male with last ventral ending in a rather sharp point, the superior appendages reach forward to a very short extension of seventh segment.

Length, 8 mm; forewing, 10.

FORMOSA, Urai, June 1. Type, M. C. Z. No. 20192.

NEOPERLA KLAPALEKI sp. nov.

Female.—Pale yellowish; a large black spot in ocellar area, and a narrow black one on clypeus; pronotum with a broad black stripe through middle, the front and sides narrowly black; mesonotal humps dark; tip of abdomen scarcely darkened; legs pale, upper edges of femora and tibiæ, and the extreme tips of tarsi dark brown. Wings hyaline, not darkened, venation pale, costal veins only a little paler than others.

Ocelli of moderate size, about two diameters apart, about twice as far from the eyes; superior boss rather large, transverse, about as near to ocelli as to eye. Pronotum much broader than long, slightly narrowed behind, front corners acute, hind corners rounded, middle area plainly marked, side carina curved

at each end, surface of sides plainly roughened; tip of abdomen shows the last segment projecting in an even curve; ventral plate scarcely convex in middle.

Forewing with about eleven costals, four subcostals, six median and seven cubital crossveins; two branches from radial sector; crossvein from radius to sector not oblique, and interstitial with that from radial sector to medius, and of about the same length, radial cell almost as long as radius to base of wing; hind wing with eight cubital crossveins, two branches to radial sector.

Length, 15 mm; forewing, 19.

FORMOSA, Planan, May 11. Type, M. C. Z. No. 20194.

NEOPERLA FORMOSANA Okamoto.

Rokki, May 16; Hassenzan, June 22 and 23; Suisha, June 1; Hori, June 6; Funkito, June 8. Common.

AMPHINEMURA FLAVICOLLIS Klapálek.

Hassenzan, June 22 and 27; Hori, June 9; Urai, April 1; Bukai June 13; Sozan, March 29; Mushn, May 18.

AMPHINEMURA NIGRICOLA Navás.

Arisan, June 3 and 4; Taiheizan, May 9.

PROTONEMURA BREVILOBATA Klapálek.

Rokki, June 16; Sozan, March 29; Urai, April 1; Hori, June 9; Taihoku, March 27.

NEMOURA PLUTONIS sp. nov.

Female.—Jet black, polished, wings faintly paler in middle of some cells, clypeus triangular; ridge across at antennæ prominent; ocelli small, a little nearer to eyes than to each other; eyes large and prominent. Pronotum about as long as broad. Wings elongate, about six median and eight cubital crossveins; radial sector rounded at base, without stump of a vein; median arises longer than first median crossvein before radial sector, its base before first median crossvein nearly straight, not plainly curved; first anal vein bent in a long curve beyond anal cell; second anal vein forked more than length of end of anal cell beyond anal cell; subcostal crossvein beyond radial subcostal crossvein about twice the length of the latter vein.

Length, 10 mm; forewing, 11 to 12.

FORMOSA. Sozan, March 30, and Hassenzan, June 22. Type, M. C. Z. No. 20191.

SMOPALOSOLE DENTATA Klapálek.

Arisan, May 23, June 3; Moji, April 17; Hassenzan, June 22; Hori, June 8; Urai, April 1; Kusukasu, April 12; Musha, May 18; Taiheizan, May 6.

SIALIDÆ

PROTOHERMES COSTALIS Walker.

Rokki, May 13; Hori, June 19.

NEOCHAULIODES FORMOSANA Okamoto.

Antsu, April 28; Mount Kannon, April 28.

SIALIS KUMEHILE Okamoto.

Several females all from Taiheizan, May 8, are probably of this species, which was described from Okinawa Island.

RAPHIDIDÆ

RAPHIDIA FORMOSANA Okamoto.

Hassenzan, June 24; Arisan, June 4

DILARIDÆ

DILAR (NEPAL) FORMOSANUS Okamoto and Kuwayama.

Similar in size and appearance to *Nepal hornei;* marks on forewings about the same; legs more distinctly marked with dark at tips of joints than in *N. hornei*, and the processes on antennæ rather darker than in that species; thorax dark on sides, pronotum with the usual row of four pale spots. On head the anterior wart plainly smaller than posterior warts (in *hornei* about equal in size); joints of antennæ becoming elongate sooner and the processes very plainly shorter than in *hornei;* for example, the fourth process in *hornei* more than reaches the base of antenna, while in this it is far short of that distance; male claspers larger and more elongate than in *hornei*. Forewing with thirteen subcostal crossveins, seven to nine radials, four branches to the second radial sector, four crossveins between first and second radial sectors, four between first radial sector and medius, the outmost of these crossveins a somewhat gradate row, but slanting obliquely outward behind, only two crossveins between median forks, five crossveins between lower medius and cubitus, and four crossveins between branches of cubitus. Hind wing with venation similar to that of *hornei*, but with only three or four crossveins between radius and radial sector (six or seven in *hornei*). Pupillæ hardly distinct.

Length of forewing, 8 mm; width, 3.

FORMOSA, Musha, May 20 (*Gressitt*).

Described from a female. The type was said to have but one radial sector; I have two males which have two, as all allied forms, and the wings are more banded than indicated in original description, however, it is not likely that there are two species in this section on Formosa.

DILAR TAIWANENSIS n. sp.

Dull yellowish, with yellowish to tawny hair; some brownish on clypeus, second joint of antennæ brown below, processes dark brown; mesonotum with a dark brown spot in the middle; abdomen brown; legs with a distinct brown mark at knees, tip of tibia, and less distinctly at tips of the tarsal joints. Forewings faintly marmorate with pale brown, quite distinctly in apical part of costal area, fairly plain behind the cubitus, in the apical area rather faintly, in the midbasal area scarcely noticeable; pupilla very distinct and surrounded by a brown cloud. Where the brown marks are at all plain they are arranged in narrow transverse bands, about a dozen in the area behind cubitus; where these marks touch veins the veins are brown, elsewhere pale; hind wings dull yellowish; no marks, except the one pupilla.

Forewings with eleven subcostal crossveins, not evenly spaced, about twelve radials, also unevenly spaced, on one wing five branches of radial sector, on the other, three branches; between medius and cubitus about seven to nine crossveins; between branches of cubitus five crossveins; between forks of first radial sector four crossveins; all crossveins irregularly placed, no semblance of rows.

Hind wing with first radial sector not united to second near base, but quite separate and with an extension back to base of medius; second radial sector with about five branches; basal cubital cell very elongate, more so than usual, two crossveins between medius and cubitus, one near base, the other towards tip; two median crossveins; two between first radial sector and medius, one near base, other far out towards tip, four crossveins between the two radial sectors, pupilla between second and third, eight radial crossveins, unevenly spaced; about twenty-eight costals; crossveins show little tendency to be in rows (so different from *nietneri*, *marmoratus*, *harmandi*). Vertex rather narrowly elevated, smooth middle area quite narrow, especially in front, hairy wart each side no wider than smooth space, an-

terior wart much smaller than others; antennæ with joints bearing long processes about as in *D. corsicus*. Pronotum in front with two subtriangular scalelike lobes.

Forewing, length, 13 mm; width, 5; hind wing, length, 11.5; width, 5.

FORMOSA, Arizan, June 4 (*Gressitt*). Type, M. C. Z. No. 20229.

CONIOPTERYGIDÆ

CONIOPTERYX ALBATA Enderlein.

Specimens from Taihejzan, Sozan, Sakahen, Musha and Hassenzan, May and June, agree with this Japanese species.

MALACOMYZA PULVERULENTA Enderlein.

From Kurarn, Bukai, Pianan, Musha, and Hassenzan, in May and June.

In most cases the crossvein from subcosta to radius is interstitial with the radial crossvein, and sometimes the mediocubital crossvein is not its length before the fork of medius; the elevated rounded black spots on the mesonotum are very prominent.

CONIOCOMPSA FURCATA sp. nov.

Face brown, hairy; palpi black, short and thick, vertex elevated, smooth, yellowish; antennæ dull yellowish, thick, joints narrowed at base, clothed with pale yellowish hair. Notum dark brown, anterior lobes elevated, transverse polished; legs dull yellowish femora much darker. Forewings with many large, often connected, pale brown marks; large ones over most of the basal part of space between subcosta and radius, and between radius and radial sector, spots over the three principal crossveins, and spots around or near the ends of various veins (some variation in the size and connections of these spots), hind wings unmarked.

Forewing with median vein plainly forked towards tip, basal part of medius very tenuous and indistinct, but the two enlarged spots for bristles plain; base of radial sector broken, apical part suddenly narrowed, radial and radial-subcostal crossveins interstitial, base of cubital fork very faint.

Hind wings with venation similar to that of *C. vesiculigera*, the median vein unforked, basal part indistinct but just before the crossvein a swelling for a bristle; branches of cubitus connected by a crossvein near margin.

Length, 3.5 mm

FORMOSA, Hassenzan, June 27 (*Gressitt*). Type, M. C. Z. No. 20212.

OSMYLIDÆ

SPILOSMYLUS JAPONICUS Okamoto.

Suisha, June 1; Rokki, May 13 and 16; Kuraru, May 5; Chirifu, May 19.

This Formosan species has been identified by Esben-Petersen as *S. tuberculatus* of the Malay Peninsula, and, following him, by Nakahara. At about the same time Okamoto described *S. japonicus*, which is close to *tuberculatus*, and has, like that species, twelve radial and twelve cubital crossveins. The markings are also similar. *Spilosmylus modestus* from the Sunda Islands and the Philippines is also near, in fact *modestus* may be the same as *tuberculatus*, there being only minor differences in markings. The differences are: In *japonicus* (both Japanese and Formosan specimens) the first crossvein from median to radial sector ends on the sector before the origin of the first branch; in *tuberculatus* (and *modestus*) this crossvein ends out on the first branch of radial sector. In *japonicus* the bulla is plainly longer than high, while in *tuberculatus* (and *modestus*) the bulla is nearly circular.

HEMEROBIIDÆ

NOTIOSMILLA SUBOLIVACEA Nakahara.

FORMOSA, Hassenzan, June 22; Taihoku, May 2. LOOCHOO ISLANDS, Iriomote Island, August 20 and 21.

ANNANDALIA CURTA Needham.

Two from Hori, June 8, and Rokki, June 13; one from the Sauter lot sent by Esben Petersen as *maindroniua* Navas. *Curta* is an older name. Quite possibly both are *iniquus* Hagen, but the three Hagen types differ from all the *curta* I have seen (including two from Peradeniya, Ceylon) in that the second of the gradate veinlets is more than its length before the first, and the third is more than its length beyond the fourth; in *curta* these veinlets form a much more even row.

NINGUTA DELTOIDES Navás.

Two from Arisan, June 2. These are not as evenly marked as the Japanese form; the wing is mostly pale, with many pale brown marks, and some darker marks along the subcosta, the middle and outer gradates are in a dark line (although three of the outer gradates are hyaline white); the inner gradates are not noticeably marked and from the inner end of the series

there is a silvery white line curving back towards the hind margin of the wing, and then back to the base of the wing.

MEGALOMUS FORMOSANUS sp. nov.

Face pale; a dark band across below antennæ, antennæ and palpi pale, unmarked; vertex dark, as also pronotum and mesonotum; a pale spot on vertex by side of eye, one on anterior side of pronotum, and one on side of anterior lobes of mesonotum, the three spots in a row. Metanotum pale with a large brown spot each side and a long black one in the middle; pleura with some dark spots. Legs pale, front tibiæ dark near base and near tip; abdomen pale brown, lateral sutures black.

Wings with more or less distinct bands of brown, mostly oblique; one before first gradate series is the broadest; a dark brown spot just beyond stigma between radius and radial sector, a larger spot over several of the upper gradates of outer series, another near basal angle of wing, one before stigma; about eight smaller spots along radius, and three along cubitus, other smaller spots or dots on some veins; upper gradates of both series brown, and small brown spots along borders of wing. Hind wing with a cloud over upper outer gradates, and faint clouds at outer angle and middle of hind border.

Forewings broad as usual; venation very similar to the European *M. hirtus*; in hind wing the inner gradates nearer to base; in forewing seven, in hind wing six, branches of radial sector.

Expanse, 19 mm.

FORMOSA, Arisan, June 4. Type, M. C. Z No. 20197.

Bestreta japonica Navas, said to be related to *Megalomus*, is a larger insect, the basal joint of antenna paler than rest, and other differences

MESOMORIA SPINULOSUS sp. nov.

Head pale yellowish a dark brown mark under each eye; antennæ pale yellowish, not darkened near tip; pronotum pale, broad, brown side margins; mesonotum also with broad, brown stripe each side, pale through middle; metanotum mostly dark, scutellum pale; abdomen pale brown; legs pale. Wings not much marked, veins with dark spots or dots, a larger mark on basal angle, and crossvein across cubitus dark brown; gradates dark.

Wings moderately narrow, costal area as narrow as in *M. humeralis*, three radial sectors, last forked three times; six inner gradates, next to last much before last, seven outer gradates;

in both series each gradate well separated; crossvein between median and radius close to base. Hind wing with radial sector forked three times; three inner gradates, five or six outer ones

Expanse, 16 mm.

FORMOSA Koripapono, April 17; Shonoryo, June 11; Arisan, May 26. Type, M. C. Z. No. 20198.

In general appearance this is similar to *H. japonicus*, but the male genitalia are different.

MICROMUS NOVITUS Navás.

Two from Arisan, June 6, and Hasenzan, June 23.

MICROMUS SAUTERI E. Peterson.

Many specimens from Formosa and Iriomote Island.

CHRYSOPIDÆ

NAGURA MATSUMURÆ Okamoto.

One from Rokki, May 17.

NOTHOCHRYSA JAPONICA McLachlan.

Riran, April 20.

NOTHOCORYSA UCHIDÆ Nawaguma.

One specimen of this fine species from Hori, June 16.

ANKYLOPTERYX OCTOPUNCTATA Fabricius.

FORMOSA, Hori, June 6. LOOCHOO ISLANDS, Iriomote Island, August 20.

ANKYLOPTERYX DOLESCHALI Brauer.

One from Iriomote Island, Loochoo Islands, August 20.

ANKYLOPTERYX DELICATULA sp. nov.

Body mostly green, venter, pleura and face whitish. A dark brown spot each side under eye, and one each side on clypeus; each side on face close to eye and below antennæ is a dark dot, basal joint of antenna with a dark line on outer side, rest wholly pale; a black dot between bases of antennæ; pronotum pale in middle, green on sides, a dark spot on each side in front; mesonotum with a dark stripe on sides extending back along margins of mesoscutellum, a dark mark on sides of metascutellum, legs with a dark dot on front and middle tibiæ, and tips of tarsi dark.

Wings with green venation; basal subcostal crossvein and extreme base of some radial crossveins black, also near base the veins in two black spots black; the first of these spots is out

from the anal angle along the ends of four veins, second larger and over the ends of first anal vein up to third cubital cell and over base of that cell; along hind margin a few faint clouds at ends of three or four veins, and a similar faint cloud over the lowest of inner gradates, and still fainter clouds over some of the others; stigma with a short dark mark at base; outer end of some of costals also dark. Hind wing with a long dark margin from anals out to near middle of hind margin, often extending up a bit on the veins. In general structure, width of costal area, shape of divisory cell, curvature of radial sector, and other characters it is very similar to *octopunctata;* eleven radial crossveins, six cubital crossveins beyond divisory, five inner gradates, six to seven outer.

Forewing, length, 11 mm; width, 4.5. Type, M. C. Z. No. 20224.

Loochoo Islands, Okinawa Island, August 31 (*Gressitt*)

Differs from all other species by the dark marks at base of wings and from *octopunctata* by lack of dark in the stigma of hind wing.

Key to the species of Chrysopa.

1 Antennæ black towards base; head and antennæ at base reddish; gradates black; large species, hairs on veins very short ... *ruficeps.*
Antennæ pale ... 2.
2 Venation wholly pale ... 3.
Venation partly black, at least some of the gradates ... 4.
3. A dark spot each side on the face ... *nigrispecus.*
No such spot ... *petersenii.*
4. Mesonotum black across front, the black extending out on the costal margin for a short distance; three spots in a row on face; costal area very broad towards base ... *decorata.*
Characters not as above ... 5.
5. Both first and second joints of antennæ with dark mark on outer sides, several spots on face; crossveins mostly black ... *cognatella.*
At most a spot or stripe on basal joint, face with few marks not so many crossveins black ... 6.
6. Face with a large X-mark between the antennæ, eight cubital crossveins beyond the divisory ... *furcifera.*
Face without an X-mark ... 7.
7. Basal joint with a red or black mark on the outside; six cubital crossveins beyond the divisory ... 8.
Basal joint without any marks, eight cubital crossveins beyond the divisory cell ... 9.
8. Cheeks with black spot; hardly any costal cells twice as broad as long ... *astur.*
Cheeks unmarked; pronotum with dark dot each side; many costal cells fully twice as broad as long ... *endora.*

9. Palpi pale; pronotum not dark on sides ..... 10.
Palpi mostly black, pronotum dark on sides; radial sector but little curved ..... *marenda*
10. Four black spots on the face ..... *cognata*
No black spots on the face ..... *adonis*

CHRYSOPA COGNATELLA Okamoto.

LOOCHOO ISLANDS, Okinawa Island, July 6. Agrees well with description, except that there is no reddish margin to pronotum. Known previously from Japan proper.

CHRYSOPA DECORATA E. Petersen.

FORMOSA Hassenzan, June 24; Shinten, April 3. LOOCHOO ISLANDS, Okinawa Island, August 31.

CHRYSOPA HABALIS Walker.

Several from Ruran, April 19 and 20. This is *C. formosana* of E. Petersen and *C. peterseni* Okamoto. There is an earlier *C. peterseni* by Navas from Greece (1911).

CHRYSOPA ANPINGENSIS E. Petersen.

Taihoku, June 29. I believe that *C. boninensis* of Okamoto is the same form

CHRYSOPA FORMOSANA Matsumura.

FORMOSA, Hassenzan, June 22; Kuraru, August 12. LOOCHOO ISLANDS, Iriomote Island, August 23 and 24. This is *C. sauteri* E. Petersen.

CHRYSOPA ADONIS sp. nov.

Pale yellowish or greenish; face, antennæ, and palpi unmarked, as also the pronotum. Wings with green longitudinal veins and many of the crossveins dark or black, gradates, costals on basal half, end forks of anal, and crossvein above to cubitus wholly black; radials and cubitals dark in the middle, some of the branches of cubitus to margin dark; outer forks unmarked. Stigma fairly distinct, although crossveins continue through it. Hind wings with gradates and some of costals partly or wholly dark, some radials dark in middle. Forewings not acute, with rather long hairs on veins, some on costals as long as cells; many costal cells two to three times as broad as long, twenty-five costals to stigma, fifteen to sixteen radials, eight cubitals beyond the divisory, six branches of radial sector before gradates, the first ending much before end of the divisory vein.et; nine gradates in each row, mostly not their length apart, the two rows slightly divergent above, outer row no nearer to margin than to inner row; divisory cell rather small, its base only

slightly oblique, postcubital area more than twice, almost three, as wide as cubital area. Hind wings with eight gradates in each row, subparallel, and the outer nearer to inner row than to margin, where radial sector meets medius a fairly large triangle.

Forewing, length, 17 mm; width, 6.

FORMOSA, Hassenzan, June 26 (*Gressitt*). Type, M. C. Z. No. 20223.

CHRYSOPA AZTLE sp. nov.

Greenish yellow, a pale yellow stripe through middle of dorsum; a large black spot on each cheek; palpi pale, somewhat marked with black; basal joint of antennæ with a black mark on outer side; thorax and legs unmarked. Forewings with largely greenish venation, but gradates black, costals partly dark at outer ends, the usual crossveins near base dark, and indistinctly dark on a few other veins; in hind wings only the gradates and costals dark.

Basal joint of antennæ short, broad, globose; pronotum a little longer than broad, narrowed in front, finely short haired.

Forewings hardly acute; hairs on veins of moderate length; eighteen costals before stigma, ten to eleven radials, six cubitals beyond the divisory, four branches of radial sector before gradates, first ending much before end of divisory cell; four inner gradates, seven outer, each well separated from next of row, the two rows subparallel, hardly as near each other as outer to margin; radial sector only slightly sinuous, hardly any costal cells twice as broad as long, postcubital area one and a half times as broad as the cubital area.

Hind wing with three inner gradates, six outer, rows widely separate, the outer much nearer to outer margin than to inner row; a small elongate triangle where radial sector meets medius.

Forewing, length, 11 mm; width, 3.5.

LOOCHOO ISLANDS, Iriomote Island, August 24 (*Gressitt*). Type, M. C. Z. No. 20225.

CHRYSOPA EUDORA sp. nov.

Yellowish; palpi pale, last joint partly dark; basal joint of antenna with a red line on outer side, vertex with a red mark each side close to the eye; pronotum with a dark dot near middle of each side; mesonotum with a faint reddish spot on each anterior lobe. Forewings with mostly greenish venation; gradates very plainly black, several crossveins towards base of wing wholly black; costals, radials, and cubitals often dark at one or

both ends, marginal forks and branches of cubitus unmarked; stigma hardly noticeable, hind wings with some gradates partly dark, otherwise venation pale. Forewings acute at tip; hairs on veins of moderate length; twenty-five costals, twelve radials, six cubitals beyond divisory, five branches of radial sector before gradates, the first ends much before end of divisory cell; seven inner, eight to nine outer gradates, in subparallel rows, outer only a little nearer to margin than to inner row; third and fourth cubital cells each with two branches to margin, fifth with one (in most species it is the fourth that has but one, but it varies somewhat); many costal cells fully twice as broad as long; post-cubital area twice as broad as cubital area.

Hind wings with seven gradates in each row; where radial sector meets medius a much larger triangle than usual.

Pronotum much longer than broad, and much narrowed in front; basal joint of antenna not very globose, rather elongate.

Forewing, length, 15 mm; width, 5.

FORMOSA, Hassenzan, June 24 (*Gressitt*). Type, M. C. Z. No. 20226.

CHRYSOPA MARCIDA sp. nov.

Pale yellowish; a black mark each side on clypeus; palpi practically wholly black; antennæ unmarked, basal joint scarcely globose; pronotum with red-brown stripe on each side margin; notum unmarked, abdomen greenish. Forewings with veins largely pale, gradates dark, costals often partly dark, and usual crossveins near base dark, stigma not distinct, crossveins continuing right through in unbroken series.

Hind wings with gradates scarcely darkened, otherwise pale.

Forewings scarcely acute at tip, hairs on veins moderately long, some on costals equal the cells; about twenty-six costals to where the first subcostal starts, but nine more beyond to tip; fourteen radials, eight cubitals beyond the divisory, three or four branches of radial sector before gradates, the first ending much before end of divisory cell; nine or ten inner, eight outer, gradates, the inner row extending basad, outer row nearer to inner than to outer margin; postcubital area almost twice as broad as cubital area.

Hind wings with nine inner, eight outer gradates, the inner row with two gradates more basad. Pronotum scarcely as long as broad, much narrowed in front.

Forewing, length, 14 mm; width, 5.

FORMOSA, Arisan, May 25 (*Gressitt*) Type, M. C. Z. No. 20227.

Besides the above species, *Chrysocera formosana* Okam. is from Formosa, a form with long cerci at tip of abdomen of male. Navas has described two: *Mallada stigmatus*, 1924, which must be close to *C. peterseni*, but his figure of the stigma is broader than in that species; *Chrysopa feana*, 1929, which has a red line on the basal joint of antennæ, a red stripe on each side on the pronotum, the sides of meso- and metanotum dark. I have seen none so marked.

Chrysopa ruficeps McLach. is a large species with very short hairs on the veins, venation pale, but the gradates black. What Okamoto called *ruficeps* is said to have venation wholly pale; I doubt if the true *ruficeps* occurs on Formosa.

Chrysopa cognata is a well-known species of Japan proper, with four spots on the face.

Chrysopa furcifer is also a well-marked species of Japan.

Chrysopa remota Walk. is recorded by Okamoto. It was described from two specimens from the Navigators Islands (Samoa) and one from the Loochoo Islands. Petersen has described and figured the species from Samoa, and since the Loochoo Islands are over 4,000 miles from Samoa it is very improbable that the specimen from Loochoo Islands is of the same species as those from Samoa.

Chrysopa basalis Walk. was described from the Loochoo Islands; it is quite possible that it is the same as *C. petersena*.

MYRMELEONIDÆ

NOMIA ELEGANS sp. nov.

Head with a large black band above below, and between antennæ from eye to eye, below, face pale, a narrow pale band above from eye to eye, rest of vertex black; palpi wholly pale, very short; antennæ almost black, some joints towards base very narrowly pale, basal and ring joints very pale. Pronotum pale, lateral margins behind sulcus, a narrow median line, a spot each side in front, and a streak in middle of each side of hind part black or almost so; hair quite long and mostly black. Anterior lobes of mesonotum black in front, pale above, large black spots inward of each wing, connected across base of scutelli, latter black through the middle; pleura pale, with a broad black streak, broader in front. Legs pale, femora dark near tips, especially above; front tibiæ dark in front, others with subbasal and apical dark marks; tarsi scarcely darkened. Abdomen with short, mostly black hair, venter pale, above dark, large pale mark on base of third segment and less distinctly

beyond, genital parts pale. Wings hyaline, venation black and white, longitudinal veins usually in streaks, crossveins usually wholly black or wholly white, most of the white ones in basal half, and in a large patch before and beyond rhegma; subcosta dark at base of each costal crossvein, about ten elongate and several smaller dark marks between subcosta and radius; several smaller clouds along cubitus, another at union of cubital fork and first anal vein, a still larger one over and up from rhegma; many marginal forks with small dark marks; stigma white, dark at base; in hind wings more veins dark; stigma white, a distinct cloud at rhegma, and traces of the spots between radius and subcosta. Antennæ long, rather widely separated at base; palpi very short; vertex somewhat elevated, truncated across middle, with a median impression. Legs slender, not very long, femora cylindrical; hind pair largely black-haired, others with some white hairs; front tarsus nearly as long as tibia, basitarsus equals next two joints together, but shorter than apical joint, spurs little more than two joints, only slightly curved; abdomen short.

Forewing with costals from middle out mostly forked, and connected by oblique crossveins, thus making two rows of cells; apical area with one row of gradates; four or five crossveins before radial sector, beyond about sixteen before stigma, two beyond stigma; eight or nine branches of radial sector, sector arising plainly before main cubital fork; basal cubital fork distinct; first anal bending up near tip and running into cubital fork; second anal in an even curve free of first anal, bending to touch third anal at one point; just beyond a crossvein back to first anal; third anal forked.

Hind wing with radial sector arising much before cubital fork, one crossvein before it; first anal bending down opposite cubital fork, and connected to the fork once, six branches to hind margin, second anal forked, upper branch connected once to first anal.

Body, length, 22 mm; forewing, length, 31; width, 9.

FORMOSA, Sakaheu, July 13 (*Gressitt*). Type, M. C. Z. No. 20193.

This genus, described from Assam, belongs to the Dendroleoninæ, and to the tribe Dendroleonini; the hind basitarsus being a little shorter than the apical joint would bring it near *Glenoleon* and *Platyleon*; it looks very similar to the latter genus, but the second and third anals of forewing touching will readily separate it.

GLENUROIDES OKINAWENSIS Okamoto.

One specimen from Okinawa Island, Loochoo Islands, July 5.

DISTOLEON PARVULUS Okamoto.

One specimen from Okinawa Island, Loochoo Islands, July 5.

This species was described as a *Myrmeculturus*, but Okamoto's figure shows that it is a *Distoleon*, in appearance very much like the others. It might be noted that *Feinerus formosanus*, of Navas, is the same as *Formicaleo formosanus* Okam., and both are doubtless the same as *Distoleon dirus*, which is widely spread. I have specimens of *D. dirus* from Foochow, China, as well as from the Malay Peninsula and other localities.

GAMA MATSUOKAE Okamoto.

Several from Rokki, May 15 and 17; Hori, May 25, June 6. *Gama* is the first synonym of *Creagris*, which is preoccupied.

HAGENOMYIA ASAKURAE Okamoto.

One from Sozan, June 29; I have others sent by Okamoto. *Hagenomyia brunneipennis* Peters. and *Myrmeleon ochraceopennis* Nakahara appear to be one species, related closely to *H. micans* of Japan proper.

MYRMELEON PUNCTINERVIS sp. nov.

Similar to *M. formicarius* in appearance, but smaller and with much slenderer wings. Color similar, but lateral scars on vertex pale; no median extension of black of face onto clypeus, black extending down at each lateral corner; pronotum with a narrow pale mark on each anterior side, and two small pale spots near middle of front. Wings with most of the crossveins, especially costals, and those in radial and median areas, and the longitudinal veins in radial area, with pale dots (in *formicarius* mostly wholly dark and the longitudinal veins with pale and dark streaks). Venation denser than in *formicarius*, thus between radius and radial sector there are 18 to 20 crossveins before stigma and four or five beyond stigma (in *formicarius* ten to twelve before stigma and two beyond). About 45 costals before stigma, nine or ten branches of radial sector. Forewing with a very distinct intercubital vein for a long distance parallel to cubitus, the area between in first part with but one series of cells, farther out two series.

Length, body, 25 mm; forewing, length, 27; width, 5.7.

FORMOSA, Hori, June 15 (*Gressitt*). Type, M. C. Z. No. 20200.

Esben Petersen records a small specimen of *M. formicarius* from Formosa; quite possibly it is this species.

SOGRA NEGLIGENS Navás.

One from Kuraru, May.

HEOCLISIS KAWAII Nakahara.

One from Kuraru, May.

ASCALAPHIDÆ

ACHERON TRUX Walker.

Many specimens, from various localities, some wholly clear-winged; others are partly or wholly dark.

SUBPALAMITUS FORMOSANUS Petersen.

Two males from Rokki, May 16; also one from Foochow, China (*Kellogg*).

SUBPALASCA FORMOSANA Okamoto.

One specimen from Formosa.

SUBPALASCA UMBROSA Petersen.

One male specimen, Kuraru, May 10, not fully colored; one female from Chirifu, May 19; two females from Hori, June 9; in none are the wings embrowned. A smaller female from Bukai, June 13, may be different; it has less white hair below.

MANTISPIDÆ

EUCLIMACIA BADIA Okamoto.

Two specimens from Kuraru, August 10 and 11.

Kuwayama compares it to *E. tagalensis;* the latter species differs not only in lacking the pronotal spots, but the posterior part of the pronotum is not as long as in *badia*, the tubercles are smaller, the dark costal streak is much narrowed, and the whole posterior part of the vertex is black.

EUMANTISPA TAIWANENSIS Kuwayama.

One specimen from Bukai, June 11, agrees closely with the description based on one specimen.

MANTISPA ORIENTALIS E. Petersen.

Two specimens from Hassonzan, June 24 and 26.

Three specimens, one each of Petersen, Stitz, and Kuwayama, had the pronotum entirely black; both of mine have a pair of very distinct pale stripes, reaching almost to hind margin; the larger specimen (forewing, 20 mm) is otherwise close to Petersen's description, the smaller specimen (forewing, 14 mm) has a pale stripe each side through the meso- and metanotum. The larger specimen has three branches from the first radial cell in one wing. In both the wings are plainly tinged with

pale yellowish brown, as Petersen noted. This will be the most useful character to determine the species.

MANTISPA FORMOSANA Okamoto.

Several from Rokki, May 13; Chirifu, May 18; and Kusukusu, April 12. The branches of the radial sector vary from three to five and are not always constant in opposite wings, so I think the varieties given by Stitz and Kuwayama are simply synonyms.

MANTISPA TRANSVERSA Shiraki.

LOOCHOO ISLANDS, Iriomote Island, August 20 to 26. Several specimens.

This species was based on one specimen, and was unknown to Kuwayama in his revision. In most of these specimens the pale band across the anterior part of pronotum is broken into two rounded spots; the face has the usual black stripe; the antennæ, except the yellow basal joint, are black; scutella mostly yellow, a yellow transverse mark inward from base of each wing; pleura with two large black marks on both meso- and metapleura. Coxæ and trochanters dark, rest of legs yellowish except dark on tips of tarsi, and on basal part of hind tibia. Front legs largely yellowish, femora with brown streak inside, fainter outside tibia with short, sometimes faint, streak outside, wholly brown, except upper edge, on inside.

The veins are all dark, in both wings the anal vein dark (in *formosana* the anal vein pale and inconspicuous). The pronotum is a little heavier than in *formosana*, faintly transversely wrinkled, but not scabrous or hairy as in *formosana*. Thus it belongs in the genus or subgenus *Mantispilla* as I have modified it. It is similar in thoracic marks to *M. spilonota* of Ceylon, but that species has no black band on the vertex.

Body, length, 8 to 11 mm; forewing, 7.5 to 10.

None of the specimens examined show the slightest sign of stripes on the pronotum; however, I would expect that they do occur.

ILLUSTRATIONS

Plate 1

Fig. 1 *Schistoperla collaris* sp. nov.; head and pronotum
2. *Neoperla kiapaiehs* sp. nov.; ventral plate.
3. *Togoperla aequalis* sp. nov.; ventral plate.
4. *Schistoperla collaris* sp. nov ; male from below
5. *Neoperla signatalis* sp. nov.; male genitalia.
6. *Schistoperla collaris* sp. nov ; male from behind
7. *Schistoperla collaris* sp. nov.; ventral plate.
8. *Togoperla aequalis* sp. nov.; male genitalia.
9. *Neoperla uniformis* sp. nov., ventral plate.
10. *Tyloppyx signata* sp. nov.; male genitalia.
11. *Conecompsa furcata* sp. nov ; fore and hind wings.

Plate 2

Fig. 12. *Perpseeus singularis* sp. nov.; forewing
13. *Megalomus formosanus* sp nov., genitalia.
14. *Proquilla marginepunctata* Hagen; long-winged form
15 *Hageniella formosana* sp. nov.; forewing.
16. *Kolbia serialis* sp. nov ; forewing.
17. *Dinar taiwanensis* sp. nov.; forewing, prothoracic lobes, basal part of antenna.
18 *Lepium enderleini* sp nov.; fore and hind wings.
19 *Hemerobius spiniperus* sp. nov.; genitalia.

Plate 3

Fig. 20 *Chrysopa adonis* sp. nov ; venation near divisory cell
21. *Chrysopa eudora* sp. nov ; venation near divisory cell.
22. *Stenopsocus externus* sp. nov.; forewing
23. *Cecilius similaris* sp. nov., forewing.
24. *Chrysopa maroida* sp. nov.; venation near divisory cell.
25. *Stenopsocus tibialis* sp. nov.; forewing.
26. *Paramphientomum nigrinepa* sp nov ; fore and hind wings.
27. *Hemicaelius transversus* sp. nov.; forewing.
28. *Cecilius confusus* sp. nov.; forewing.
29. *Chrysopa aster* sp. nov., venation near divisory cell.
30. *Isophanes decipiens* sp. nov.; forewing.

PLATE 1.

PLATE 2

PLATE 6.

BOTTOM DIATOMS FROM OLHON GATE OF BAIKAL LAKE, SIBERIA

By B. W. Skvortzow

Of Harbin, Manchoukuo

EIGHTEEN PLATES

INTRODUCTION

Baikal Lake belongs to the Yenisei River basin of Siberia and extends from 51° 48′ to 55° 46′ north latitude and from 103° 44′ to 109° 57′ east longitude. The length of Baikal is about 623 kilometers, the breadth 74 kilometers, and the water area 33,000 square kilometers; its basin is 582,000 square kilometers. Baikal apears to be the deepest lake in the world, with a maximum depth of about 1,523 meters. Its bed is below sea level to 1,060 meters. In its great depth the bottom is covered with fine brown slime, but near the shore the bottom is stony and sandy. The water is fresh and very cold. According to A. V. Voznesenski, near the village of Listvenischinoe the water temperature is 0.1° C. in January, 0.01° C. in February, 0.0° C. in March, 1.2° C. in May, 4.5° C. in June, 6.2° C. in July, 7.1° C. in August, 7.9° C. in September, 6.9° C. in October, 3.6° C. in November, and 0.4° C. in December; the mean temperature is 3.2° C. The Baikal water is largely saturated with oxygen and has very little mineral matter in solution. During half of the year Baikal Lake is covered with ice.

BIOLOGY OF BAIKAL

The biology of Baikal is of great scientific interest. According to Prof. G. I. Wereschtschagin its fauna and flora include about 1,300 kinds of animals and plants with many species and genera endemic. The following are some of the inhabitants of Baikal: The Baikal seal (*Phoca siberica* Gmel.), a species related to the Caspian seal; about 35 species of fishes (Comephoridæ and Cottocomephoridæ) with 1 family, 7 genera, and 17 species endemic. One peculiar fish is "Golomianka" (*Comephorus baicalensis* Dyb. and *C. dybowskii* Kor.) with a transpa-

Cymbella cymbiforme.
Cymbella Naviculiformis.
Cymbella gastroides subsp. *substomatophora.*
Encyonema ventricosum.
Amphora ovalis.
Amphora lineolata.
Cocconeis Placentula.
Cocconeis marginata.
Cocconeis stimulata.
Cocconeis salina.
Gomphonema dichotomum.
Gomphonema capitatum.
Gomphonema acuminatum var. *coronatum.*
Gomphonema olivaceum.
Gomphonema intricatum.
Gomphonema fractum.
Gomphonema assymetricum.
Achnanthidium exile.
Achnanthidium coarctatum.
Denticula thermalis.
Denticula sinuata.
Nitzschia thermalis.
Nitzschia parvula.
Nitzschia tenuis
Nitzschia communis var *minuta.*
Rhoicosphenia curvata.
Surirella biseriata.
Surirella Smithii.
Surirella nobilis.
Campylodiscus spiralis.
Odontidium Harrisonii.
Odontidium mesodon.
Meridion circulare.
Fragilaria capucina.
Fragilaria virescens.
Synedra lunaris var. *genuina* and var. *complyla.*
Synedra bilunaris.
Synedra gracilis.
Synedra Vaucheriae.
Tabellaria flocculosa var *centricosa.*
Epithemia turgida var. *genuina.*
Epithemia Sorex
Epithemia gibba.
Epithemia Zebra var. *genuina* and var. *saxonica.*
Epithemia Porcellus.
Eunotia Diodon.
Eunotia bidens var *Dybowski.*
Eunotia Popillo.
Melosira granulata
Melosira tenuis.
Melosira hyalina.
Melosira subflexilis.
Orthosira arenaria var. *typica* and var. *granulata.*
Orthosira Roeseana.
Cyclotella operculata
Cyclotella Kuetzingiana.
Cyclotella Astraea.
Ceratoneis lunaris.

In this list I left the original nomenclature of R. Gutwinski. Four new forms are reported by him from Baikal but not figured. The first one, *Cymbella gastroides* subsp. *substomatophora*, is *Cymbella tumida* or a variety of *Cymbella Stuxbergii*. The next, *Eunotia bidens* var *Dybowski*, is a large biconstricted diatom. The third one, *Schizostauron tatricum*, according to P T. Cleve, is identical with *Navicula pupula*, and the last, *Orthosira arenaria* var. *typica* and var. *granulata*, all belong to *Melosira arenaria*. R. Gutwinski states that *Cyclotella Astraea* and *Melosira arenaria* were the commonest diatoms in the lake. He found *Cyclotella Astraea* at depths of from 10 to 1,000 meters. I suggest that this *Cyclotella* belongs to our *C. baikalensis*.

The next very accurate list of about 200 diatoms from Baikal was given by Prof. V. Dorogostasky in 1904, with *Navicula*

lata fo. *major*, *Gomphonema dentata*, and *Surirella Baikalensis* described as new. The first one can be named as *Pinnularia lata*, the next *Didymosphenia dentata*—one of the largest and stoutest diatoms known as endemic in Baikal. *Surirella Baikalensis* of Dorogostaisky I have not yet seen in my slides. Several other works, dealing with the diatom flora of Baikal Lake, appeared during 1922–1929. In 1922 Prof. K. I. Meyer reported 112 forms with a description of new *Melosira islandica* var. *baikalensis*. In 1924 S. M. Wislouch gave the diagnoses of *Melosira baikalensis*, *Gomphonema quadripunctatum* and var. *hastata*, *Cymbella Ehrenbergii* var. *Gutwinskii*, and *Cymbella Stuxbergii* var. *intermedia*. In 1925 appeared an account by Prof. K. I Meyer and L. B Reinhard with the following new diatoms: *Cyclotella compta* var. *radiosa* fo. *major*, *C. striata* var. *magna*, *Cymbella cistula* var. *baicalensis*, and *C. cistula* var. *excelsa* fo. *lata*.

The late Prof A H. Henckel was the first, in 1925, to note the presence of a large *Coscinodiscus* in Baikal Lake. In 1927 Prof K I. Meyer found *Coscinodiscus* frustules in samples collected near Selenga River and stated that these valves are fossils transported by the river to the lake. The author of this paper, together with Prof. K I. Meyer in 1928, published a preliminary contribution to the diatoms of Baikal Lake with a list of about 460 diatoms among which were 160 new species and forms. The present paper is a new report on Baikal diatoms based on a little bottom sample collected by Prof K. I. Meyer at the depth of 33 meters near the Olhon Gate of Baikal Lake July 29, 1916. I have examined about a hundred microscopic slides from this place and have taken great care to identify and illustrate the forms and to correct the mistakes of my previous work. The result was unexpected; I give 304 species, varieties, and forms, among which 148 are new. The paper includes detailed descriptions and drawings of almost all the forms. The present bottom sample contained abundant spicules of sponges and many individuals of large *Cyclotella baikalensis* and *Didymosphenia geminata*.

THE DIATOM FLORA OF BAIKAL

The diatom flora of Baikal Lake is easily recognizable as an Arctic one. Its forms are large and very beautiful, with a predominance of naviculoid forms of colder water. This robust development is due mainly to the low temperature, low mineral content, high oxygen, abundant nourishment, and strik-

ing transparency of the Baikal waters. These conditions are quite unique, and it is not surprising that the diatom flora is rich and peculiar. Baikal is a cold arctic lake and has one of the richest bottom diatom floras known, both in number of individuals and in diversity of species. Two-thirds of the diatoms from the bottom material from Olhon Gate belongs to the Naviculaceæ (106) forms, with the large genera *Navicula*, *Amphora*, *Cymbella*, and *Gomphonema*. The genus perhaps showing a markedly strong development is *Amphora*, which contributes the relatively large number of 18 forms. About two-thirds of the Baikal flora, as listed in the present paper, is endemic. The present study shows a certain similarity of the Baikal diatoms to those of Tanganyika Lake, Africa; to Neogene fresh-water floras of Nippon; to Tertiary diatom floras of Hungary; to the recent flora of Demerara River, Paraguay, South America; and to some forms widely represented in oceans. All this can be explained only by the help of Prof. G. I. Wereschtschagin's theory of the origin of the Baikal fauna and flora. The 304 Baikal diatoms, as to origin, can be classified in five groups: (*a*) Siberian and subalpine elements, (*b*) Tertiary fresh-water remnants and species of tropical origin, (*c*) marine elements of marine relicts, (*d*) brackish-water species, and (*e*) elements of uncertain origin.

The first group is the largest, with about one-half of the recorded species. The second, with Tertiary fresh-water remnants or relicts and species of tropical origin, contains about 31 forms. The third group, with marine elements, contains only 6 or 7 species. The last—the elements of indistinct origin—is represented by a large series of Baikal endemics to which I have not yet found relationships. Herewith I give these preliminary lists, as follows:

(A) SIBERIAN AND SUBALPINE ELEMENTS

Melosira arenaria and var. *baikalensis*
Stephanodiscus Hantzschii.
Stephanodiscus astræa var. *minutula*.
Tetracyclus lacustris.
Tabellaria fenestrata.
Opephora Martyi and var. *baikalensis*.
Cavitonema arcus.
Fragilaria pinnata and var. *baikalensis*.
Synedra ulna and its varieties.
Synedra acus and its varieties.
Synedra Vaucheriæ var. *capitellata*.
Synedra rumpens.
Eunotia præcipia and var. *inflata*.
Cocconeis placentula var. *lineata* and var. *baikalensis*.
Cocconeis diminuta.
Encocconeis incgensis.
Achnanthes Clevei var. *rostrata*.

Achnanthes Oestrupii and var. *minuta*
Achnanthes baikalensis.
Achnanthes lanceolata and its varieties.
Achnanthes Peragallii.
Rhoicosphenia curvata.
Frustulia rhomboides var. *amphipleuroides*.
Gyrosigma Spencerii var. *nodifera*.
Gyrosigma acuminatum var. *baikalense*.
Caloneis Zachariasi and its varieties.
Caloneis latiuscula and its varieties.
Caloneis silicula and var. *major*.
Caloneis Schumanniana and its varieties.
Caloneis ventricosa.
Neidium dilatatum and fo. *curta*.
Neidium dubium and its varieties.
Neidium affine var. *baikalense*.
Neidium lanceolata.
Diploneis ovalis and var. *nipponica*
Diploneis domblittensis and var. *baikalensis*.
Diploneis puella and var. *baikalensis*
Diploneis Boldtiana var. *baikalensis*.
Diploneis elliptica var. *ladogensis*.
Diploneis marginestriata var. *nipponica*.
Diploneis baikalensis.
Diploneis Meyeri.
Diploneis turgida and var. *bipunctata*
Diploneis lata and its varieties.
Stauroneis phoenicenteron.
Stauroneis anceps var. *baikalensis*.
Stauroneis baikalensis.
Navicula ompudata.
Navicula argenea.
Navicula americana.
Navicula bacillum
Navicula papula and its varieties.
Navicula flexa and its varieties.
Navicula silicea.
Navicula delicatula.
Navicula atomus.
Navicula costulata.
Navicula costiloides
Navicula cryptocephala and its varieties.
Navicula rhynchocephala.
Navicula lanceolata and its varieties.
Navicula gracilis.
Navicula pseudogracilis.
Navicula formosana var. *absona*.
Navicula hasta.
Navicula pastrum
Navicula vulpina.
Navicula tuscula
Navicula Meyeri.
Navicula anglica.
Navicula exigua.
Navicula rostellata.
Navicula placentula and its varieties.
Navicula menisculus.
Navicula subocculata and its varieties.
Navicula acuta.
Navicula lacustris and its varieties.
Navicula scutelloides var *baikalensis*.
Navicula amphibola var. *curta*.
Navicula dalmatica.
Pinnularia notaris.
Pinnularia leptosoma.
Pinnularia gibba var. *baikalensis*.
Pinnularia major and fo. *minor*.
Cymbella Hustedtii.
Cymbella amphicephala var. *unipunctata*.
Cymbella navicula.

Cymbella lacustris fo. *baicalensis*.
Cymbella sinuata.
Cymbella ventricosa.
Cymbella heteropleura var. *minor*.
Cymbella cuspidata.
Cymbella Ehrenbergii.
Cymbella Meisteri.
Cymbella Gutwinskii.
Cymbella prostrata.
Cymbella parva.
Cymbella cistula with its varieties.
Cymbella Stuxbergii.
Cymbella capricornis.
Amphora ovalis and its varieties.
Amphora Normanii.
Amphora perpusilla.
Amphora mongolica and its varieties.
Amphora costulata
Amphora sibirica and var. *procera*.
Didymosphenia dentata.
Didymosphenia geminata and its varieties.
Gomphonema quadripunctatum and its varieties.
Gomphonema olivaceum.
Gomphonema innata and var. *elegans*.
Gomphonema intricatum and its varieties.
Gomphonema ventricosum.
Gomphonema firma.
Gomphonema dichotoma.
Gomphonema lanceolatum and var *capitata*.
Epithemia all species.
Rhopalodia gibba and var. *mongolica*.
Nitzschia all species recorded.
Cymatopleura all species.
Surirella lucarii and var. *helvetica*.
Surirella biseriata var. *bifrons* fo. *punctata*.
Surirella granulata.
Surirella turgida fo. *baikalensis*.
Surirella gracilis.
Surirella didyma var. *minor*.
Surirella ammodes.
Surirella undentata.
Surirella conifera and var. *punctata*.
Surirella Lacus Baikali and its varieties.
Surirella pauciduns and var. *punctata*.

(B) TERTIARY FRESH-WATER REMAINS AND SPECIES OF TROPICAL ORIGIN

Melosira baikalensis, abundant in Baikal Lake and as fossil near Moscow. A remnant of glacial flora.

Fragilaria spinosa, a species akin to *F. robusta* fossil from Pensacola and to large marine *Opephora*.

Fragilaria Lacus Baikali also akin to marine *Opephora* species.

Eunotia enemomodon, known from Columbia River, Oregon, North America, and recently reported from Onega Lake, northern Europe.

Eunotia Clevei, abundant in Baikal. Recent in Ladoga and Onega Lakes in Europe, recent in southern China and as a fossil in Sweden, in the State of Washington, North America, and in Neogene deposits in Nippon.

Eunotia Lacus Baicali, a species related to *E. Clevei*, may be also regarded as a relict.

Achnanthes calcar, recent in Europe, common as a fossil from the *Ancylus* epoch.

Gyrosigma baikalensis, akin to *G. distorum* and var. *Parkeri*, known from marine and brackish waters.

Calonels simplex, a new species, akin to *C. nipponica* from Biwa Lake, Nippon.

Diploneis suborbicularis var. *baikalensis*. The type is reported from New Zealand.

Navicula confervacea var. *baikalensis*. The type is common in tropical regions.

Navicula subhamulata var. *parallela*. Reported by me from Biwa Lake, Nippon

Navicula antiqua, a new species from Baikal, akin to *N. macandrinoides*, a fresh-water fossil from Columbia River, Oregon, North America.

Navicula exigens, also a new diatom, connected with the previous species.

Navicula magna and its varieties, a diatom of very primitive structure.

Navicula vulpina var *oregonica*, known as a fossil from Oregon, North America.

Navicula Lacus Baikali and its varieties a very distinct species closely related to *N. Hauerii* of Grunow, from brackish-water fossils of Hungary. Another related species, *N. Phi* is a marine species from Seychelles.

Navicula subplacentula var. *baikalensis*, a very distinct diatom, closely related to *N. subplacentula* from the bottom of Tanganyika Lake, Africa.

Navicula annulata var *baikalensis*. The type is known from Demerara River, South America.

Navicula Wislouchii, known only from Baikal, is related to *N. scoliopleuroides*, known from thermal waters of Budapest.

Pinnularia Lacus Baikali and the related species *P. obscura* and *P. viridiformis*, all three have distinct, peculiar, central pores and are very primitive forms; they are probably remains of Tertiary time.

Cymbella turgida, a species common in tropical countries.

Cymbella incognita var *baikalensis*. The type is known as a fresh-water fossil.

Cymbella australica fo. *elongata*. The type is known from Australia, Nippon, New Zealand, and Hanka Lake of the Maritime Province of Siberia.

Amphora delphinea, known from fresh water from Demerara River, South America, and var *minor* from Grand Pond, North America, and also from Demerara River and from Kizaki Lake, Nippon.

Surirella margaritifera of Hustedt, known from fresh water of Tanganyika Lake, Africa

Surirella Nyassa var *baikalensis*. The type is known from plankton of Nyassa Lake, Africa.

Surirella ovalinoides var. *baikalensis*, a very distinct species. The type is reported from fresh water, Tanganyika Lake, Africa

Campylodiscus spp. of Baikal, all new to science; probably all of them are relicts of Tertiary time.

(c MARINE ELEMENTS OR MARINE RELICTS

Cyclotella baikalensis abundant in Baikal. Closely related to *C. stylorum* from the seashore of tropical regions and nearly akin to *C. striata*, common in marine and brackish waters.

Coscinodiscus radiatus, a marine species very common in the Caspian Sea. As thinks Prof. K. I Meyer, large *Coscinodiscus* in Baikal Lake are fossils, brought by rivers.

Neidium Lacus Baikali, a distinct species closely related to *Navicula Kelleri* of Pantocsek, known as a marine fossil from Hungary.
Caloneis relicta, akin to *C. permagna* from brackish water of North America.
Amphora obtusa var. *baikalensis*. The type is known from the North Sea and the Atlantic and Indian Oceans.
Amphora Proteus var. *baikalensis*. The type is widely distributed in oceans.
Surirella prokeniilis, a new diatom akin to *S. curvifacies* known from marine waters.

(D) BRACKISH-WATER SPECIES

Navicula cruciculo var. *obtusata*.
Navicula anglica var. *subsalsa*.
Navicula peregrina and var. *kefvingensis*.

(E) ELEMENTS OF INDISTINCT ORIGIN

Excocconeis baikalensis.
Achnanthes Lacus Baikali.
Achnanthes profunda.
Achnanthes Meyeri.
Achnanthes striata.
Achnanthes hastata
Caloneis delicatula.
Navicula unipunctata.
Navicula paradoxa.
Navicula granulata.
Navicula denticulata.
Pinnularia pectinalis and var. *rostrata*.
Pinnularia crassa.
Amphora retunda.
Surirella ovophora.

DIATOMS FROM OLHON GATE, BAIKAL LAKE

MELOSIRA BAIKALENSIS (K Meyer) Wislouch. Plate 1, figs. 1 to 12.

Melosira baikalensis (K. Meyer[7]) Wislouch, S. Wislouch, Beiträge zur Diatomeenflora von Asien, 2. Neuere Untersuchungen über die Diatomeen des Baikal-sees, Bericht d. Deutsch. Bot. Gesellsch. 42[a] (1924) 165.

Melosira islandica O. Müll. var. *baicalensis* K. Meyer, K. Meyer, Quelques recherches scientifiques sur la flore des algues du lac Baikal, Journ. Moscow Branch of Russian Bot. Soc. 1 (1922) 7, 8, 20.

Melosira polymorpha Bethge subsp. *granulata* (Ralfs) Bethge var. *baicalensis* (Wisl.) Bethge, H. Bethge, Melosira und ihre Planktonbegleiter (1925) 35.

Melosira baicalensis (K. Meyer) Wislouch, Skvortzov and Meyer, Contribution to the diatoms of Baikal Lake (1928) 4, pl. 1, fig. 1; A. P. Skabitschewski, Über die Biologie von Melosira baicalensis (K. Meyer) Wisl., Russisch. Biologisch. Zeitschrift (1929) 93–124, pl. 3.

Melosira baicalensis (Meyer) Wisl. in P. J. Wertschnaja, Über eine relikte Algenflora in den Seeablagerungen Mittelrusslands, Archiv für Hydrobiologie 20: 124–132, Abb. 1.

Frustules robust with cell wall about 0.0015 to 0.002 mm thick. Height of frustules, about 0.038 to 0.072 mm; breadth, 0.0045 to 0.0368. Alveoli in parallel or slightly oblique striæ, 7.5 to 9

in 0.01 mm; alveoli in rows, about 3 to 7.7 in 0.01 mm. Alveoli near the discus sometimes form longitudinal lines. Sulcus indistinct, forming a thicker siliceous ring from the inside part of the frustule. Pseudosulcus also indistinct. Auxospores round, sporangial frustule as in *Melosira italica* with thick cell wall and fine alveoli. A very distinct and variable species. The young immature and mature frustules are so different that they seem to comprise several different forms. According to the size and the shape of alveoli three forms can be recognized, as follows:

MELOSIRA BAIKALENSIS (H. Meyer) Wislouch fo. TYPICA fo. nov. Plate 1, figs. 1, 2, 4 to 6, and 10 to 12.

Alveoli small or large, irregular on the cell wall.

MELOSIRA BAIKALENSIS (H. Meyer) Wislouch fo. OBLONGA-PUNCTATA Skv. and Meyer. Plate 1, fig. 3.

Melosira baikalensis (H. MEYER) Wisl. fo. *oblonga-punctata* Skv. and Meyer, SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 4, pl. 1, fig. 1.

Frustules with oblong parallel alveoli. Uncommon.

MELOSIRA BAIKALENSIS (H. Meyer) Wislouch fo. COMPACTA fo. nov. Plate 1, figs. 7, 7, and 9.

Frustules with large and very thickly disposed alveoli. Common.

Melosira baikalensis is a very abundant species in Baikal. In plankton it is found, according to A. P. Skabitschewski, during the whole year with the maximum in spring and at the beginning of summer. Besides Baikal, *Melosira baikalensis* was noted also in Dalai-nor Lake in the western part of northern Manchuria and as a fossil in lake deposits near Moskow, in European U. S. S. R.

MELOSIRA BINDERANA Kütz. Plate 1, figs. 24 and 25.

Melosira Binderana Kütz., Fr. HUSTEDT, Die Kieselalgen (1927) Lief. I, 246–248, fig. 103.

Frustules barrel-shaped and slightly siliceous. Frustule breadth, 0.0034 to 0.012 mm. Height of cell-half about 0.0021 to 0.0042 mm. Sulcus and kollum absent. Frustule cell wall hyaline with one row of distinct beads near the discus rim. Discus denticulate at the junction of the frustules. Very common. A plankton diatom known from the northern part of Europe and common in alpine lakes of Nippon.

MELOSIRA ARENARIA Moore. Plate 1, figs. 18 and 19.

Melosira arenaria Moore, A. SCHMIDT, Atlas Diatom (1893) pl. 179, figs. 15–20.

Frustules box-shaped, closely joined together, forming long bands. Frustule breadth, 0.042 to 0.06 mm. The height of cell-half 0.007 to 0.012 mm. Sulkus and pseudosulkus indistinct. Discus rim denticulate at the junction of the frustules. Outer area of the discus forming a broad band three-fourths the radius in width, strongly marked with closely radiating costæ, 9 to 12 in 0.01 mm. The central area punctate with irregular dots. Frustule cell wall crossed by a fine line system of small puncta, 21 to 22 in 0.01 mm. Common.

MELOSIRA ARENARIA Moore var. BAIKALENSIS var. nov. Plate 1, figs. 15, 23, and 26.

Melosira scabrosa OESTRUP, Beiträge zur Kenntniss der Diatomeenflora des Kossogolbeckens in der nordwestlichen Mongolei. *Hedwigia* 48 (1909) 93, pl. 7, fig. 20.

Differs from the type in the shape of diskus view. Outer area of the discus forming a band one-third to one-fourth the radius in width, strongly marked with closely set radiating costæ, 4 to 7 in 0.01 mm, and at the same time with a fine system of crossed lines, 18 to 20 in 0.01 mm. Central area hyaline with irregular blotches in the central part. Breadth of the frustules, 0.051 to 0.072 mm. Variety *baikalensis* is common in Baikal and reported from Kossogol Lake.

MELOSIRA ARENARIA Moore var. BAIKALENSIS fo. ORNATA fo. nov. Plate 1, fig. 14.

Dots on the surface of radiating costæ of discus rim.

MELOSIRA ARENARIA Moore var. BAIKALENSIS fo. PUNCTATA fo. nov. Plate 1, fig. 21.

A series of small and distinct puncta disposed in one longitudinal line from the zone view of the valve.

CYCLOTELLA BAIKALENSIS Skv. and Meyer. Plate 1, figs. 8, 9 to 16, and 20; Plate 2, figs. 1, 2, 4, 5 and 11.

Cyclotella baikalensis SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 5, pl. 1, figs. 3, 4.

Cyclotella striata (Kutz.) Grun. var. *magna* K. MEYER and L. REINHARD, Contribution a la flore algologique du lac Baikal et de la Transbaicalie. Bull. Moscou Nat. Hist. Soc. (1929) 207.

Valve circular; consisting of a large central area, two-thirds the diameter of the valve and a rim one-third the valve diameter. One-half of the large central area is convex or rarely

convex in the central part. All of the central area is covered with dots irregularly distributed over the entire valve and sometimes covered also with small puncta or an irregular network. The dots are of different sizes, small or large. The outer rim, or area, is strongly marked with closely set, radiating costæ. The costal zone can be divided into three parts: The narrow marginal rim with costæ 9 to 10 in 0.01 mm; the middle rim also with enlarged costæ, sometimes forming a loculiferous rim of dark striæ, 2 to 5 in 0.01 mm; and the third, central part with long, radiating, fine striæ, 12 to 15 in 0.01 mm, covered with little dots. These dots are seen only under high magnifying powers. Diameter of the valves from 0.01 to 0.113 mm. *Cyclotella baikalensis* is a variable species and seems to comprise several different forms. The following are distinguished by me:

CYCLOTELLA BAIKALENSIS Skv. and Meyer fo. TYPICA fo. nov. Plate 2, figs. 6, 7 and 10.

Valves with outer striated rim not marked in the middle with short dark dashes or lines. Central dots small or large. Diameter of the valve, 0.05 to 0.013 mm. Striæ 12 to 15 in 0.01 mm. Very common.

CYCLOTELLA BAIKALENSIS Skv. and Meyer fo. STELLATA fo. nov. Plate 2, figs. 2, 4, and 5.

Differs from the type in having irregular and elongate dots around the central dotted area. Valves larger than in form *typica*. Striæ 12 in 0.01 mm. Uncommon.

CYCLOTELLA BAIKALENSIS Skv. and Meyer fo. ORNATA fo. nov. Plate 2, figs. 1, 3, 8, 11 to 13, and 16.

The outer rim in the middle part of radiating striæ, marked with short dark dashes or lines, forming a second disk. Diameter of the valve, 0.03 to 0.08 mm. Striæ 11 to 12 in 0.01 mm. Abundant in Baikal.

CYCLOTELLA BAIKALENSIS Skv. and Meyer fo. MINUTA fo. nov. Plate 2 figs. 14, 15, and 15.

Valve minute, about 0.01 to 0.02 mm in diameter; radiating striæ 10 to 12 in 0.01 mm. Very common. *Cyclotella baikalensis* is a distinct species related to *C. stylorum* Brightwell, known from the seashores of tropical and northern districts, and to *C. striata* (Kutz.) Grun., reported largely from sea water and from the brackish water from the mouths of rivers.

STEPHANODISCUS HANTZSCHII Grun. Plate 3, figs. 1, 2 and 3.

Stephanodiscus Hantzschii Grun., Fr. Hustedt, Bacillar. (1930) 110, fig. 87.

Valve minute, slightly siliceous, circular, 0.0085 to 0.01 mm in diameter. The discus rim with one row of fine spines. Outer area with radiating rows of fine beads, 10 to 12 in 0.01 mm, with puncta 15 to 18 in 0.01 mm. Central area small, sparsely punctate with irregular dots. Very common.

STEPHANODISCUS ASTRÆA (Ehr.) Grun. var. MINUTULA (Kütz.) Grun. Plate 3, fig. 4.

Stephanodiscus astræa (Ehr.) Grun. var. *minutula* (Kütz.) Grun., Fr. Hustedt, Bacillar. (1930) 110, fig. 86.

Valve circular with surface separated into two areas. The inner part sparsely punctate with irregular dots and the outer area covered with radiating double rows of beads. Marginal spines indistinct. Diameter, 0.012 mm. Striæ 6 in 0.01 mm. Rare.

COSCINODISCUS RADIATUS Ehrenb. Plate 2, figs. 11 and 12.

Coscinodiscus radiatus Ehrenb., A. Schmidt, Atlas Diatom. (1878) pl. 60, figs. 1–6, 9, 10; pl. 61, fig. 13.

Valve circular, about 0.056 to 0.07 mm in diameter, covered with large areoles of about equal size, in the middle part 4 to 5 in 0.01 mm, near the margin 7 in 0.01 mm. Marginal rim densely beaded, forming radiating rows of beads. A distinct species known from all seas. Very common in the Caspian Sea. Several frustules were observed in the Ohon Gate sample.

TETRACYCLUS LACUSTRIS Ralfs. Plate 4, fig. 12.

Tetracyclus lacustris Ralfs, Fr. Hustedt, Bacillar. (1930) 121, fig. 95.

Frustule broad, plank-shaped in long bands. Valves in valve view elliptic to rhombic-lanceolate, narrowed towards the ends and gibbous in the middle. Length, 0.04 to 0.051 mm; breadth, 0.02 to 0.025. Transverse costæ 2, striæ 24, in 0.01 mm. Very common. Known from Arctic and northern alpine regions.

TABELLARIA FENESTRATA (Lyngb.) Kütz. Plate 4, fig. 7.

Tabellaria fenestrata (Lyngb.) Kütz., Fr. Hustedt, Bacillar. (1930) 122, fig. 98.

Valve linear with capitate ends and gibbous middle part. Length, 0.037 mm; breadth, 0.0076. Very rare. Common in European lakes.

OPEPHORA MARTYI Heribaud. Plate 4, fig. 18; Plate 6, fig. 14.

Fragilaria mutabilis Gran. var. *baicalensis* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 7, pl. 1, fig. 9.

Frustule cone-shaped with broad ends. Valve elongate-oval. Length, 0.025 to 0.049 mm; breadth, 0.0068 to 0.0085. Costæ robust, 4 to 8 in 0.01 mm. Common. Known from the bottoms of many lakes.

OPEPHORA MARTYI Heribaud var. BAIKALENSIS var. nov. Plate 1, fig. 28.

Valve minute, narrower than the type. Length, 0.0085 to 0.017 mm; breadth, 0.0017 to 0.0034. Costæ 9 to 12 in 0.01 mm. Uncommon.

CERATONEIS ARCUS Kütz.

Ceratoneis arcus KÜTZ., FR. HUSTEDT, Bacillar. (1930) 134–135, fig. 122.

Valve lunate, attenuate towards the subcapitate ends. Ventral side in the middle part slightly gibbous. Length, 0.112 mm, breadth, 0.07. Striæ 15 in 0.01 mm. Rare.

FRAGILARIA PINNATA Ehr. Plate 1, fig. 23.

Fragilaria pinnata Ehr., FR. HUSTEDT, Bacillar. (1930) 142, fig. 141.

Valve elliptic with broad ends. Length, 0.0068 mm; breadth, 0.002. Striæ robust, 9 in 0.01 mm. Common.

FRAGILARIA PINNATA Ehr. var. BAIKALENSIS var. nov. Plate 6, fig. 15.

Differs from the type in its more robust striæ, 6 in 0.01 mm. Length, 0.012 mm, breadth, 0.005. Uncommon.

FRAGILARIA SPINOSA sp. nov. Plate 1, figs. 13 and 27; Plate 4, figs. 11 and 19; Plate 6, figs. 10 and 20.

Fragilaria mutabilis Gran. var. *robusta* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 7, pl. 1, fig. 8.

Frustules plank-shaped, joined in bands with distinct spines. Valves elliptic-lanceolate, gibbous in the middle and attenuate towards the subacute ends. Length, 0.032 to 0.051 mm, breadth, 0.01 to 0.013. Costæ 4.5 to 8.5 in 0.01 mm, not striate. Intercostal spines 6 or 7 in 0.01 mm. Median line lanceolate, gradually attenuate to the ends. A variable species of peculiar type, akin to *F. robusta* Hustedt, known as a fossil from Pensacola.[1] Common in Baikal.

FRAGILARIA LACUS BAIKALI sp. nov. Plate 12, fig. 33.

Frustules linear, connected in bands. Valve linear-lanceolate, gradually attenuate towards the subacute ends. Length, 0.068

[1] Schmidt, Atlas Diatom. (1913) pl. 207, fig. 83.

mm; breadth, 0.012. Striæ robust, almost parallel, 6 in 0.01 mm. Median area narrow and linear. A distinct species, akin to *F. spinosa* sp. nov. and to large marine *Opephora*. Infrequent.

SYNEDRA ULNA (Nitzsch) Ehr. var. DANICA (Kütz.) Grun.

Synedra ulna (Nitzsch) Ehr. var *danica* (Kütz.) Grun., Fr. Hustedt, Bacillar (1930) 154, fig. 168; A. Schmidt, Atlas Diatom. (1914) pl. 303, fig. 8.

Valve long, narrow-lanceolate with slightly capitate ends. Length, 0.265 to 0.272 mm; breadth, 0.0051 to 0.0052. Striæ 9 to 10 in 0.01 mm. A plankton diatom common in Baikal.

SYNEDRA ULNA (Nitzsch) Ehr. var. BICEPS (Kütz.)

Synedra ulna (Nitzsch) Ehr. var. *biceps* (Kütz.), Fr. Hustedt, Bacillar. (1930) 154, fig. 166.

Synedra biceps Kütz. A. Schmidt, Atlas Diatom. (1914) pl. 303. figs. 10–15.

Valve linear-lanceolate with capitate ends. Length, 0.25 mm; breadth, 0.005. Striæ 9 in 0.01 mm. Uncommon.

SYNEDRA ULNA (Nitzsch) Ehr. var. SUBAEQUALIS Grun.

Synedra ulna (Nitzsch) Ehr. var. *subaequalis* Grun., A. Schmidt, Atlas Diatom. (1914) pl. 303, fig. 2.

Valve linear-lanceolate, gradually tapering from the middle to the subacute ends. Rare.

SYNEDRA ACUS Kütz. var. RADIANS (Kütz.) Hust.

Synedra acus Kütz. var. *radians* (Kütz.) Hust., Fr. Hustedt, Bacillar (1930) 155, fig. 171.

Differs from the preceding form in its more robust valves. Length, 0.17 mm; breadth, 0.0035. Breadth of the ends 0.0008 mm. Striæ 12 in 0.01 mm. Uncommon.

SYNEDRA ACUS Kütz. var. ANGUSTISSIMA Grun.

Synedra acus Kütz. var. *angustissima* Grun. Fr. Hustedt, Bacillar (1930) 155, fig. 172.

The longest and the finest species in Baikal Lake. Valve narrow-lanceolate with slightly capitate ends. Length, 0.4 to 0.5 mm; breadth, 0.003. Breadth of the ends 0.0008 mm. Striæ 13 to 14 in 0.01 mm. A typical plankton diatom.

SYNEDRA VAUCHERIAE Kütz. var. CAPITELLATA Grun. Plate 4, fig. 1.

Synedra Vaucheriae Kütz. var. *capitellata* Grun., Fr. Hustedt, Bacillar. (1930) 161, fig. 194.

Valve linear-lanceolate with inflated margins. Length, 0.022 mm; breadth, 0.0042. Striæ in the middle part interrupted from

one side of the valve, about 15 in 0.01 mm. Median line filiform. Differs from the type in its more robust striæ. Rare.

SYNEDRA RUMPENS Kütz. Plate 5, figs. 6 and 61.

Synedra rumpens Kütz., Fr. Hustedt, Bacillar. (1930) 158, fig. 176.

Valve narrow-lanceolate with attenuate, subacute ends. The middle part of the valve from both sides slightly undulate. Length, 0.04 to 0.049 mm, breadth, 0.004. Striæ 18 to 20 in 0.01 mm. Uncommon.

EUNOTIA PRÆRUPTA Ehr. Plate 4, fig. 3.

Eunotia præruptа Ehr., Fr. Hustedt, Bacillar. (1930) 174, fig. 211.

Valve convex on dorsal side, apices dilated and truncate. Length, 0.044 mm; breadth, 0.01. Striæ 8 to 9 in 0.01 mm. Rare.

EUNOTIA PRÆRUPTA Ehr. var. INFLATA Grun. Plate 4, figs. 10 and 11.

Eunotia præruptа Ehr. var. *inflata* Grun. Fr. Hustedt, Bacillar. (1930) 174, fig. 212.

Differs from the type in its more inflated valves. Length, 0.042 to 0.041 mm; breadth, 0.0085 to 0.012. Striæ 7 in 0.01 mm. Rare.

EUNOTIA SUBMONODON Hustedt. Plate 4, fig. 17.

Eunotia submonodon Hustedt, A. Schmidt, Atlas Diatom. (1913) pl. 288, figs. 18 18a.

Valve arcuate, recurved, with slightly subcapitate broad ends. Length, 0.102 mm; breadth, 0.01. Striæ irregular with marginal shorter striæ interrupted between them. Striæ 4 in 0.01 mm. Puncta 18 to 20 in 0.01 mm. Pseudonodules distinct. A distinct species, reported from Columbia River, North America, and from Povenetkoi Lake, northern Europe. Rare.

EUNOTIA CLEVEI Grun. Plate 4, fig. 6.

Eunotia Clevei Grunow, P. Cleve, Diatoms of Finland (1891) 5a, pl. 3, figs. 13-16. A. Schmidt, Atlas Diatom. (1913) pl. 290, figs. 1, 4.

Eunotia Clevei Grunow var. *sinica* Skvortzow, Alpine Diatoms from South China (1929) 40, pl. 2, figs. 2, 3; pl. 3, fig. 8.

Frustule large, broad lanceolate with broad abrupt ends. Valve gently arcuate, with slightly protracted and rounded ends. Transverse striæ regular, forming a distinct median line, following at some distance the lower margin and ending in very distinct, downward-curved end nodules. Length, 0.12 to 0.136 mm; breadth, 0.02 to 0.025. Striæ 10 to 11, puncta 12 to 13, in 0.01 mm. A variable species in Baikal Lake. Known as a

fossil in the deposits of Lake Forarn (Asnen, Sweden), in glacial clay from Hernosand, in Lake Malaren in Sweden, in deposits from the State of Washington, North America, and in the Neogene deposits near Sendai, Nippon. Recently found in Ladoga and Onega Lakes, northern Europe, in mountains near Foochow, southern China, and very common in Baikal Lake.

EUNOTIA CLEVEI Grun. var. BAIKALENSIS var. nov. Plate 4, figs. 4 to 6.

Differs from the type in its irregularly interrupted striæ along the median line.

Length, 0.111 to 0.221 mm; breadth, 0.022 to 0.03. Striæ 10 to 11 in 0.01 mm. Very common in Baikal.

EUNOTIA CLEVEI Grun. var. HISPIDA var. nov. Plate 4, figs. 9 and 13.

Differs from the type in having distinct marginal spines and furcate projections from both sides of the frustule. Length, 0.144 to 0.16 mm; breadth, 0.023 to 0.027. Striæ 9 to 10; puncta 12 to 14 in 0.01 mm. Spines 4 to 5 in 0.01 mm. Uncommon.

EUNOTIA LACUS BAIKALI sp. nov. Plate 4, fig. 1.

Valve arcuate or lunate, not attenuate towards the ends, but abruptly rounded. Striæ irregular, interrupted, forming a distinct median line. End nodules arcuate and large. Length, 0.158 to 0.175 mm; breadth, 0.02 to 0.025. Striæ 11, puncta 5 to 8, in 0.01 mm. A peculiar species related to *E. Clevei* Grun. Uncommon.

COCCONEIS PLACENTULA (Ehr.) var LINEATA (Ehr.) Cleve. Plate 5, fig. 11.

Cocconeis placentula (Ehr.) var *lineata* (Ehr.) Cleve, Fr. Illustrat. Bacillar. (1930) 190, fig. 202.

Differs from the type in its upper valve being crossed from each side by 8 to 10 broad, longitudinal, blank, undulating and zigzag bands. Length, 0.03 mm; breadth, 0.018. Striæ 24 in 0.01 mm. Common.

COCCONEIS PLACENTULA (Ehr.) var. BAIKALENSIS var. nov. Plate 5, figs. 6, 7, and 8.

Valve elliptic-lanceolate, slightly attenuate towards the rounded ends. Length, 0.012 to 0.024 mm; breadth, 0.0068 to 0.014. Upper valve with a broad elliptic axial area. Striæ marginal, 18 in 0.01 mm, with three longitudinal bands. Lower valve with very fine striæ, about 30 in 0.01 mm. Differs from the type in its upper valve having broad-elliptic axial and central areas. Common.

COCCONEIS PLACENTULA (Ehr.) var. ROUXII Brun and Herib. Plate 5, figs. 42 and 43.

Cocconeis placentula (Ehr.) var. *Rouxii* Brun and Heribaud, J. Herbaud, Diatomees d'Auvergne (1893) 45, pl. 1, fig. 3.

Valve elliptic with rounded ends. Length, 0.023 to 0.029 mm; breadth, 0.0136 to 0.017. Upper valve with striæ 13 in 0.01 mm. Puncta 15 in 0.01 mm. Lower valve with striæ 12 to 13, and puncta 15, in 0.01 mm. Differs from the type in its more robust striæ. Common in Baikal. Reported from France as fossil (Auvergne) and recent, and from Onega Lake, northern Europe.

COCCONEIS DIMINUTA Pant. Plate 5, figs. 39 and 39.

Cocconeis diminuta Pant., Fr. Hustedt, Bacillar. (1930) 190–191, fig. 265.

Valve elliptic with broad rounded ends. Length, 0.0085 mm; breadth, 0.006. Upper valve with robust subradiate striæ, 24 in 0.01 mm. Median line narrow. Lower valve with fine radiate striæ, 35 in 0.01 mm. Differs from the type in its coarser striæ of the upper valve. Rare.

EUCOCCONEIS BAIKALENSIS sp. nov. Plate 6, figs. 36, 41, 44, 50, 57, and 58.

Valve linear-lanceolate with broad, somewhat parallel margins and abruptly attenuate, subtruncate ends. Length, 0.03 to 0.073 mm; breadth, 0.013 to 0.0185. Upper valve with oblique, linear axial area, on one side of which in the middle part of the valve there is a horseshoe area. Striæ robust, slightly radiate, 10 to 12 in 0.01 mm, finely punctate. Lower valve with narrow, linear, axial area and strongly ramate, punctate striæ, 11 to 13 in 0.01 mm. Puncta 18 in 0.01 mm. Striæ forming in the central area a broad stauros, truncate outward. The middle striæ alternately longer and shorter. A large and distinct species.

EUCOCCONEIS ONEGENSIS Wisl. and Kolbe. Plate 5, figs. 63 and 64.

Eucocconeis onegensis Wislouch and Kolbe, New diatoms from Russia (1916) Journ. Microbiologie 3: 269–271, pl. 3 fig. 5–6, Beiträge zur Diatomeenflora des Onega-sees (1927) 33, 72, pl. figs. 2, 3; Skvortzow, Diatoms from Biwa Lake, Honshu Island, Nippon (1936) pl. 6, figs. 4, 5.

Valve lanceolate, broad-undulate at the middle, gradually attenuate towards the ends. Length, 0.022 mm; breadth, 0.012. Upper valve with oblique axial area. Central area dilated, irregularly larger on one side of the valve than on the other.

Lower valve with narrow axial area and narrow stauros, widened and truncate outward. Striæ of the upper and lower valves 18 in 0.01 mm, punctate. Puncta about 24 in 0.01 mm. Rare. Known from Onega Lake, northern Europe, and from Biwa Lake, Nippon.

ACHNANTHES LACUS BAIKALI sp. nov. Plate 5, figs. 16 and 27.

Valve broad elliptic-lanceolate with somewhat attenuate ends. Length, 0.015 mm; breadth, 0.009. Upper valve with narrow, lanceolate axial and central areas. Striæ radiate, not lineate, 9 in 0.01 mm. Lower valve also with narrow axial and central areas and more distinct puncta. Striæ 7 to 8 in 0.01 mm. A distinct species which shows a relation to *A. delicatula* Kutz.[3]

ACHNANTHES PROPINQUA sp. nov. Plate 5, figs. 3, 24, 31, and 37.

Valve elliptic with broad rounded ends. Length, 0.015 to 0.029 mm; breadth, 0.01. Upper valve with lanceolate, narrow axial area. Striæ robust, radiate, 6 in 0.01 mm. Striæ with double rows of puncta. Puncta 24 in 0.01 mm. Lower valve with lanceolate axial and central areas. Striæ radiate, 11 in 0.01 mm, distinctly lineate. Common.

ACHNANTHES MEYERI sp. nov. Plate 5, figs. 1, 2, 32, and 33.

Valve rhombic-lanceolate with short acute ends. Length, 0.01 to 0.018 mm; breadth, 0.0068 to 0.014. Upper valve with robust, radiate costæ, 10 to 11 in 0.01 mm and a horseshoe-shaped area on one side of the valve. Axial and central areas narrow-linear. Lower valve with fine radiate striæ, about 24 in 0.01 mm. Axial area narrow; central area slightly dilated. Near the margin a distinct longitudinal stria from each side of the valve. This species is related to *A. Oestrupii* (A. Cleve) Hustedt. Named in honor of Prof. K. I. Meyer, who has collected this form in Baikal.

ACHNANTHES STRIATA Skv. and Meyer. Plate 5, figs. 11, 12, and 45 to 47.

Achnanthes striata SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 10, pl. 1, fig. 23.

Valve elliptic-lanceolate, attenuate towards the acute ends. Length, 0.015 to 0.03 mm; breadth, 0.008 to 0.009. Upper valve with robust and radiate striæ, 9 in 0.01 mm distinctly punctate. Axial and central areas narrow. Lower valve with radiate striæ, 12 in 0.01 mm, alternately longer and shorter. Axial and central areas broad lanceolate. Median line filiform. This is a distinct species akin to *A. Clevei* Grun., from which it dif-

[3] Hustedt, Bacillar. (1930) 202, fig. 295

fers in its nonpunctate striæ of the lower part of the valve. Very common.

ACHNANTHES HASTATA Skv. and Meyer. Plate 5, figs. 21 and 23.

Achnanthes hastata Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 10, pl. 1, fig. 22.

Valve lanceolate with narrow acute ends. Length, 0.022 to 0.035 mm; breadth, 0.0085. Upper valve with narrow, linear, axial and central areas, and with parallel striæ slightly radiate to the ends, 10 in 0.01 mm. Striæ not lineate. Lower valve also with narrow axial and central areas. Striæ parallel, 10 to 11 in 0.01 mm, slightly radiate at the ends and fine-punctate. The middle striæ more distinct. Uncommon.

ACHNANTHES EXIGUA Grun. var. BAIKALENSIS var. nov. Plate 5, figs. 29, 30, 42 and 43.

Valve elliptic with rostrate ends. Length, 0.01 to 0.0136 mm; breadth, 0.005. Upper valve with fine, radiate striæ, 15 to 20 in 0.01 mm, more distinct in the middle part. Axial and central areas narrow-lanceolate. Lower valve with narrow axial and central areas. Striæ radiate, 15 to 20 in 0.01 mm. The lower valve differs from that of the type in its narrow central area and its more robust striæ. Uncommon.

ACHNANTHES CLEVEI Grun. var. ROSTRATA Hustedt. Plate 5, figs. 21 and 24.

Achnanthes Clevei Grun. var. *rostrata* Hustedt, Bacill. (1930) 204, fig. 295.

Valve lanceolate with rostrate ends. Length, 0.012 mm; breadth, 0.005. Upper valve with linear axial area and robust, radiate costæ, 12 in 0.01 mm. Intermediate spaces distinctly punctate. Lower valve with very narrow axial area and small orbicular central area. Striæ radiate, 18 in 0.01 mm, distinctly punctate. Known from European lakes. Uncommon.

ACHNANTHES OESTRUPII (A. Cleve) Hustedt. Plate 5, figs. 9, 10, and 26.

Achnanthes Oestrupii (A. Cleve) Hustedt. Fr. Hustedt, Bacillar. (1930) 201, fig. 301.

Valve broad-elliptic, attenuate towards the ends. Length, 0.02 to 0.03 mm; breadth, 0.009 to 0.015. Upper valve with radiate striæ, 10 in 0.01 mm, and on one side of the valve in the middle part with a distinct horseshoe-shaped area. Axial area narrow-lanceolate. Upper valve with fine striæ, about 24 in 0.01 mm. Axial area narrow; central area orbicular. Baikal specimens are larger than the type. Common. Known as a fossil in Europe and as a recent species in alpine lakes.

ACHNANTHES OESTRUPII (A. Cleve) Hustedt var. MINUTA var. nov. Plate 5, fig. 45.

Valve elliptic-lanceolate, attenuate towards the subrostrate ends. Length, 0.0056 mm; breadth, 0.0034. Upper valve with linear axial and central areas. Striæ radiate, fine, 28 in 0.01 mm. Lower valve with narrow axial and central areas. Striæ very fine, about 30 in 0.01 mm. Differs from the type in its smaller size and subrostrate ends. Rare.

ACHNANTHES BAIKALENSIS Skv. and Meyer. Plate 5, figs. 34 and 35.

Achnanthus baikalensis Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 10, pl. 1, fig. 21.

Valve rhomboidal-lanceolate with acute ends. Length, 0.025 to 0.032 mm; breadth, 0.01 to 0.011. Upper valve with lanceolate axial and central areas. Striæ robust, not lineate, radiate, 7 to 8 in 0.01 mm, with a horseshoe-shaped area on one side of the valve. Lower valve with lanceolate axial area, suborbicular central area, and distinct filiform median line and radiate striæ, 8 to 9 in 0.01 mm. The median striæ more distinct than the others. This species resembles *A. lanceolata* Breb., but differs in its rhomboidal shape and more robust striæ.

ACHNANTHES LANCEOLATA Breb. Plate 5, figs. 12, 13, 23, and 28.

Achnanthes lanceolata Breb., Fr. Hustedt, Bacillar. (1930) 207, fig. 306*a*.

Valve elliptic-lanceolate with slightly attenuate and broad rounded ends. Length, 0.015 to 0.037 mm; breadth, 0.007 to 0.0085. Upper valve with slightly radiate striæ, 10 to 12 in 0.01 mm, and a horseshoe-shaped area on one side of the valve. Axial and central areas narrow. Lower valve with radiate striæ, about 11 to 12 in 0.01 mm. Axial area narrow, central area slightly enlarged. Fairly common.

ACHNANTHES LANCEOLATA Breb. var. ROSTRATA Hustedt. Plate 5, fig. 18.

Achnanthes lanceolata Breb. var. *rostrata* Hustedt, Fr. Hustedt, Bacillar. (1930) 208, fig. 306*b*.

Differs from the type in its rostrate ends. Length, 0.009 mm; breadth, 0.005. Upper valve with robust striæ, about 12 in 0.01 mm, and a horseshoe-shaped area in the middle part of the valve. Rare.

ACHNANTHES LANCEOLATA Breb. var. ELLIPTICA Cleve. Plate 5, fig. 14.

Achnanthes lanceolata Breb. var. *elliptica* Cleve, Fr. Hustedt, Bacillar. (1930) 206, fig. 306*c*.

Valve elliptic. Length, 0.0065 mm; breadth, 0.0034. Costæ 18 in 0.01 mm. Smaller than the type. Rare.

ACHNANTHES PERAGALLII Brun and Herib. Plate 1, fig. 19.

Achnanthes Peragallii Brun and Herib., Fr. Hustedt, Bacillar. (1930) (1930) 207, fig. 300.

Valve broad-elliptic with rostrate ends. Length, 0.01 mm; breadth, 0.0048. Upper valve with slightly radiate striæ, about 18 in 0.01 mm, and with a horseshoe-shaped area in the middle part of the valve. Lower valve not seen. Smaller than the type. Common.

ACHNANTHES CALCAR Cleve. Plate 5, fig. 4.

Achnanthes calcar Cleve. Fr. Hustedt, Bacillar. (1930) 207, fig. 305.

Valve broad-elliptic. Length 0.01 mm; breadth, 0.0076. Upper valve with fine radiate striæ, about 25 in 0.01 mm. On one side in the middle of the valve there is a horseshoe-shaped area. The lower valve not examined. Rare. Known in fresh water and as a fossil from the *Ancylus* epoch in northern Europe.

RHOICOSPHENIA CURVATA (Kütz.) Grun. Plate 14, fig. 10.

Rhoicosphenia curvata (Kütz.) Grun., Fr. Hustedt, Bacillar. (1930) 211, fig. 311.

Frustule curvate, cone-shaped. Valve clavate. Length, 0.017 mm; breadth, 0.0034. Axial area linear; central area indistinctly suborbicular. Striæ slightly radiate, 12 in 0.01 mm. Rare.

FRUSTULIA RHOMBOIDES (Ehr.) De Toni var. AMPHIPLEUROIDES Grun. Plate 16, fig. 1.

Frustulia rhomboides (Ehr.) de Toni var. *amphipleuroides* Grun., Fr. Hustedt, Bacillar. (1930) 221, fig. 326.

Valve lanceolate with attenuate and subacute ends. Length, 0.119 mm, breadth, 0.021. Central nodule elongate, median line slightly eccentric. Rare.

GYROSIGMA SPENSERII (W. Smith) Cleve var. NODIFERA Grun. Plate 5, fig. 62.

Gyrosigma Spenserii (W. Smith) Cleve var. *nodifera* Grun., Fr. Hustedt, Bacillar. (1930) 225, fig. 337.

Gyrosigma attenuatum Kütz. var. *baicalensis* Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 25, pl. 2, fig. 37.

Valve linear, slightly sigmoid, with obtuse ends. Length, 0.144 mm; breadth, 0.015. Central nodule surrounded by an elongate, oblique area. Middle striæ slightly radiate. Longitudinal and transverse striæ 15 in 0.01 mm. Rare.

GYROSIGMA BAIKALENSE sp. nov. Plate 8, figs. 64 and 65.

Valve lanceolate, slightly sigmoid. Ends more or less produced, turned in contrary directions. Median line sigmoid,

central area slightly flexuose with radiate striæ. Transverse and longitudinal striæ 17 to 18 in 0.01 mm. Length, 0.178 to 0.187 mm; breadth, 0.018. A distinct species akin to *G. distortum* W. Sm. and var. *Parkeri* Harrison, reported from marine and brackish waters. Variety *Parkeri* is found also in fresh water.

CYMATOPLEURA ACUMINATA (Kütz.) Rabh. var. BAIKALENSIS var. nov. Plate 5, fig. 46.

Valve linear-lanceolate, slightly sigmoid. Length, 0.119 mm; breadth, 0.013. Transverse and longitudinal striæ 18 in 0.01 mm. Differs from the type in its narrower valves. Rare.

CALONEIS ZACHARIASI Reichelt. Plate 9, figs. 32 and 33.

Caloneis Zachariasi Reichelt, Fr. Hustedt, Bacillar. (1930) 234, fig. 350.

Valve lanceolate, slightly undulate with subtruncate ends. Length, 0.03 to 0.052 mm; breadth, 0.009. Axial area linear; central area somewhat dilated. Median line filiform. Striæ distinctly punctate, 12 to 15 in 0.01 mm. Rare. Known from the bottoms of European lakes.

CALONEIS ZACHARIASI Reichelt var. CONSTRICTA var. nov. Plate 9, figs. 27 and 28.

Differs from the type in its constricted valve. Length, 0.022 to 0.037 mm; breadth, 0.0068 to 0.012. Striæ 15 in 0.01 mm. Rare.

CALONEIS ZACHARIASI Reichelt var. ELONGATA var. nov. Plate 9, fig. 29.

Differs from the type in having elongate valves. Length, 0.037 mm; breadth, 0.0085. Striæ slightly radiate, 15 in 0.01 mm. Puncta in distinct longitudinal striæ, 12 in 0.01 mm. Rare.

CALONEIS LATIUSCULA (Kütz.) Cleve. Plate 7, fig. 12; Plate 9, figs. 31.

Caloneis latiuscula (Kütz.) Cleve, Fr. Hustedt, Bacillar. (1930) 233, fig. 351.

Valve elliptic-lanceolate with slightly attenuate and rounded ends. Length, 0.064 to 0.072 mm; breadth, 0.014 to 0.02. Striæ 14 to 18 in 0.01 mm. Median line robust. Axial and central areas lanceolate. Striæ slightly divergent in the middle and at the ends, 14 in 0.01 mm. This species is known from large lakes.

CALONEIS LATIUSCULA (Kütz.) Cleve var. ROSTRATA var. nov. Plate 9, fig. 35.

Valve with subrostrate ends. Length, 0.063 mm; breadth, 0.015. Striæ 14 in 0.01 mm. Terminal fissures with a distinct pore. Differs from the type in its subrostrate ends, narrower valve, and more robust striæ. Uncommon.

CALONEIS SILICULA (Ehr.) Cleve. Plate 7, fig. 18.

Caloneis silicula (Ehr.) Cleve, Fr. Hustedt, Bacillar. (1930) 233, fig. 362.

Valve linear-lanceolate, slightly triundulate. Axial and central areas lanceolate, in the middle part suborbicular. Length, 0.061 mm; breadth, 0.015. Striæ 18 to 20 in 0.01 mm. Rare.

CALONEIS SILICULA (Ehr.) Cleve var. MAJOR var. nov. Plate 8, fig. 11.

Navicula Hirchaudii Pérag. in Sky and Meyer, Contribution to the diatoms of Baikal Lake (1926) 19, pl. 1, fig. 43.

Valve elongate, gibbous in the middle, with clavate, obtuse ends. Length, 0.119 to 0.141 mm; breadth, 0.018 to 0.02. Axial area broad and very distinct; central area a broad transverse fascia. Striæ 14 to 16 in 0.01 mm. slightly divergent in the middle and at the ends. Differs from variety *ventricosa* (Ehr.) Donkin and variety *Kjellmaniana* Cleve in its larger size. Common in Baikal.

CALONEIS SCHUMANNIANA (Grun.) Cleve. Plate 8, fig. 29.

Caloneis Schumanniana (Grun.) Cleve, Fr. Hustedt, Bacillar. (1930) 239–240, fig. 369.

Navicula Heneckii Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 19, pl. 1, fig. 53.

Valve almost linear-lanceolate, slightly inflated in the middle part and gradually attenuate towards the obtuse ends. Length, 0.047 to 0.061 mm; breadth, 0.0085 to 0.01. Striæ 15 to 16 in 0.01 mm. Axial area in the upper part indistinct, in the middle part enlarged, central area broad, with lunate markings on each side of the central nodule. Common.

CALONEIS SCHUMANNIANA (Grun.) Cleve var. BICONSTRICTA Grun. Plate 8, fig. 22.

Caloneis Schumanniana (Grun.) Cleve var. *biconstricta* Grun., Fr. Hustedt, Bacillar. (1930) 240, fig. 370a, b.

Valve biconstricted with undulate ends. Length, 0.068 mm., breadth, 0.012. Striæ radiate, 15 in 0.01 mm, not dilated near the lunate margins. Uncommon.

CALONEIS SCHUMANNIANA (Grun.) Cleve var. BICONSTRICTA Grun. fo. BAIKALENSIS fo. nov. Plate 7, fig. 16; Plate 8, fig. 30. Plate 9, fig. 18.

Differs from variety *biconstricta* in its striæ, dilated in the middle part of the valve. Length, 0.024 to 0.068 mm; breadth, 0.0068 to 0.014. Striæ 14 to 17 in 0.01 mm. Very common.

CALONEIS SCHUMANNIANA (Grun.) Cleve var. BICONSTRICTA Grun. fo. UNDULATA fo. nov. Plate 8, fig. 15.

Caloneis undulata Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 19, pl. 1, fig. 48.

Differs from variety *baikalensis* in its more undulate valves, robust striæ, and larger valves. Length, 0.068 to 0.076 mm; breadth, 0.011 to 0.012. Striæ 14 to 17 in 0.01 mm. Our form *undulata* has nothing to do with variety *Iremodis* Lewis, which it seems belongs to a distinct species. Common.

CALONEIS IGNOKATA sp. nov. Plate 8, fig. 26.

Valve linear, with parallel margins, and broad rounded ends. Length, 0.045 mm; breadth, 0.0085. Axial area narrow, linear; central area elliptic. Median line filiform, with distinct terminal fissures. Striæ radiate, 12 (middle), 18 (end), in 0.01 mm. A distinct species related to *C. lepidula* (Grun.) Cleve.

CALONEIS DELICATULA sp. nov. Plate 7, fig. 23.

Valve rectangular-elliptic, with cuneate ends and slightly constricted margins. Length, 0.035 mm; breadth, 0.012. Axial area narrow, somewhat dilated in the middle; central area suborbicular. Striæ divergent in the middle and at the ends, 12 in 0.01 mm, not punctate. Median line filiform, with comma-shaped terminal fissures. No longitudinal lines along the margin. Rare.

CALONEIS SIMPLEX sp. nov. Plate 8, fig. 24.

Navicula sp. Domogatsky, Materiaux pour servir a l'algologie du lac Baikal et de son bassin, Bull. de Moscou Nat. Hist. Soc. (1904) 253, pl. 6, fig. 8.

Valve constricted, lanceolate with attenuate ends. Length, 0.052 to 0.06 mm; breadth, 0.660 (middle), fissures 0.012 (ends). Median line filiform, with comma-shaped fissures. Axial area narrow; central area a broad fascia. Striæ radiate, 7 to 10 in 0.01 mm, robust, not lineate. No longitudinal lines near the margin. Akin to *C. nipponica* Skv. from Biwa Lake, Nippon.

CALONEIS RELICTA sp. nov. Plate 7, fig. 14; Plate 8, fig. 29.

Valve lanceolate with subrostrate ends. Length, 0.039 to 0.052 mm; breadth, 0.015 to 0.017. Median line straight with little, comma-shaped, terminal fissures and distinct central pores. Axial area narrow; central area slightly dilated. Striæ radiate throughout, 8 in 0.01 mm, not lineate, crossed from both sides of the median line by two, longitudinal, undulating bands, forming something like a blank area. A distinct species.

NEDIUM DILATATUM (Ehr.) Cleve. Plate 8, fig. 16.

Nedium dilatatum (Ehr.) Cleve, Fw. Hustedt, Bacillar. (1930) 246, fig. 385.

Valve broad elliptic-lanceolate with cuneate ends. Length, 0.059 mm; breadth, 0.024. Axial area narrow; central area

orbicular. Striæ fine, about 20 in 0.01 mm. On both sides of the valve near the margin are several, distinct, longitudinal lines. A north-alpine species, reported from the northern part of Europe.

NEIDIUM DILATATUM (Ehr.) Cleve fa. CURTA fa. nov. Plate 7 fig 32.

Valve broad elliptic-lanceolate with cuneate ends. Length, 0.034 mm; breadth, 0.017. Striæ radiate, 17 to 18 in 0.01 mm. Puncta 24 in 0.01 mm. Smaller and broader than the type.

NEIDIUM DUBIUM (Ehr.) Cleve. Plate 3, fig. 41

Neidium dubium (Ehr.) Cleve, Fr. Hustedt, Bacillar (1930) 246, fig 381a.

Valve elliptic with obtuse nonrostrate ends. Length, 0.031 mm; breadth, 0.012. Axial area narrow; central area orbicular. Striæ fine, 18 in 0.01 mm. Differs from the type in its subrostrate ends.

NEIDIUM DUBIUM (Ehr.) Cleve fa. CONSTRICTA Hust. Plate 3, fig. 39.

Neidium dubium Ehr. var. *constricta* Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 13, pl. 1, fig 35.

Valve slightly constricted, ends subrostrate Length, 0.034 to 0.04 mm; breadth, 0.01 to 0.013. Striæ radiate, 18 to 20 in 0.01 mm. Rare.

NEIDIUM DUBIUM (Ehr.) Cleve var. BAIKALENSIS var. nov. Plate 7, fig. 5.

Differs from form *constricta* Hustedt in its more elongate valves and the striæ, divided from each side of the valve into three longitudinal parts; namely, the marginal, the middle, and the central. The former has indistinct striæ. Axial and central areas narrow. Infrequent.

NEIDIUM IRIDIS (Ehr.) Cleve var. BAIKALENSIS var. nov. Plate 10, fig. 4.

Differs from the type in its short-lanceolate valves, with acute ends. Length, 0.078 mm; breadth, 0.03. Striæ robust, 15 in 0.01 mm. Puncta 18 in 0.01 mm. Differs from form *hercynica* (A. Mayer) Hust. in its more acute ends.

NEIDIUM LANCEOLATA sp. nov. Plate 10, fig. 3.

Valve broad-lanceolate, gradually tapering from the middle to the subacute ends. Length, 0.078 mm; breadth, 0.025. Striæ almost parallel, divergent at the ends, 11 to 12 in 0.01 mm. Puncta slightly elongate, 9 in 0.01 mm. Median line straight, enlarged in the middle with straight central pores without comma-shaped fissures, but with middle stria. Central area small, orbicular. A distinct species.

NEIDIUM LACUS BAIKALI sp. nov. Plate 7, fig. 31; Plate 10, fig. 1

Valve linear-lanceolate, narrowed towards the subacute ends. Axial area narrow-lanceolate, somewhat dilated in its median part; central area suborbicular, with slightly eccentric median line. Median line filiform, somewhat enlarged in the middle part. Terminal fissures comma-shaped. Striæ in transverse and longitudinal rows of puncta. Transverse striæ 12 to 13, longitudinal 7, in 0.01 mm. Puncta 4 to 5 in 0.01 mm. Our figure represents a valve with the system of longest and transverse striæ. Puncta not figured. A robust species of peculiar form. Differs from *N. affine* (Ehr.) Cleve in its more robust striæ and its longitudinal lines covering the entire surface of the valve. A species closely related to *Navicula Kelleri* Pantocsek, known as a marine fossil from Hungary, Europe.[8]

DIPLONEIS OVALIS (Hilse) Cleve. Plate 8, fig. 13.

Diploneis ovalis (Hilse) Cleve, P. CLEVE, Diatoms of Finland (1891) pl. 2, fig. 13.

Valve elliptic-linear with obtuse ends. Length, 0.044 mm, breadth, 0.022. Furrows very narrow, following the central nodule. Central area enlarged. Striæ 9 in 0.01 mm. Rare

DIPLONEIS OVALIS (Hilse) Cleve var. NIPPONICA Skv. Plate 4, fig. 14.

Diploneis ovalis (Hilse, Cleve var. *nipponica* SKVORTZOW, Diatoms from Biwa Lake, Honshu Island, Nippon (1936) pl. 4 fig. 11.

Valve elliptic not lineate with obtuse ends. Length, 0.12 mm; breadth, 0.051. Median line straight; central nodule quadrate, furrow narrow, closely following the central nodule. Transverse rows of alveoli 7 to 8 in 0.01 mm. Differs from variety *oblongella* (Naeg.) Cleve in its elliptic valves and larger size.

DIPLONEIS DOMBLITTENSIS (Grun.) Cleve. Plate 8, fig. 2.

Diploneis domblittensis (Grun.) Cleve, FR. HUSTEDT, Bacillar (1930) 250–251, fig. 397.

Valve elliptic with broad ends. Length, 0.017 mm; breadth, 0.01. Furrows distinct, lanceolate with alveoli. Central area quadrate. Transverse rows of alveoli radiate, 9 in 0.01 mm. Alveoli very distinct, 3 to 4 in 0.01 mm. Smaller than the type. *Diploneis domblittensis* is a bottom diatom from European lakes.

DIPLONEIS DOMBLITTENSIS (Grun.) Cleve var. BAIKALENSIS var. nov. Plate 6, figs. 7, 15.

Differs from the type in its lanceolate-rhomboidal valves with obtuse ends. Length, 0.035 to 0.042 mm; breadth, 0.02. Fur-

[8] Beiträge zur Kenntnis der fossilen Bacillarien Ungarns 2: 40, pl. 23, fig. 351.

rows broad-elliptic, closely following the central nodule. Central area suborbicular. Transverse rows of alveoli radiate, 6 to 8 in 0.01 mm. Alveoli 9 to 12, sometimes forming irregular, longitudinal rows. Common.

DIPLONEIS MEYERI sp. nov. Plate 6, fig. 11; Plate 10, fig. 10.

Diploneis elliptica Cleve var. *grosse-punctata* PANTOCSEK, in Skv. and Meyer, Contribution to the diatoms of Baikal Lake (1928) 11, pl. 1 fig. 27.

Valve elliptic with obtuse ends. Length, 0.064 to 0.093 mm; breadth, 0.032 to 0.045. Median line filiform. Furrows narrow, hyaline or with alveoli by two in each row. Central area orbicular, small. Transverse rows of alveoli radiate, 4-5 in 0.01 mm, with very large and robust alveoli, about 3 in 0.01 mm. This new species is connected with *D. domblittensis* Grun. known from fresh and brackish waters of northern Europe, and in Domblitton fossils, Gulf of Bothnia; common in the Baltic deposits of the *Ancylus* epoch.

DIPLONEIS PUELLA (Schum.) Cleve. Plate 6, fig. 1.

Diploneis puella (Schum.) Cleve, Fr. Hustedt, Bacillar. (1930) 250, fig. 294.

Valve elliptic with rounded ends. Length, 0.015 mm; breadth, 0.0035. Furrows narrow. Central area quadrate. Striæ radiate, 11 to 12 in 0.01 mm. Alveoli indistinct. Rare.

DIPLONEIS PUELLA (Schum.) Cleve var. BAIKALENSIS var. nov. Plate 6, fig. 19.

Differs from the type in its rhomboidal-lanceolate valves. Length, 0.022 mm; breadth, 0.01. Striæ radiate, 9 to 10 in 0.01 mm. Alveoli indistinct. Rare.

DIPLONEIS BOLDTIANA Cleve var. BAIKALENSIS var. nov. Plate 8, fig. 4.

Differs from the type in its more elongate valve and more robust striæ. Length, 0.039 mm; breadth, 0.01. Transverse rows of alveoli radiate, 10 to 11 in 0.01 mm. Alveoli indistinct. *Diploneis Boldtiana* Cleve is known from Viado, Finland.[4]

DIPLONEIS ELLIPTICA Cleve var. LADOGENSIS Cleve. Plate 6, fig. 4.

Diploneis elliptica Cleve var. *ladogensis* Cleve, Fr. HUSTEDT, Bacillar. (1930) 250, fig. 296.

Valve rhomboidal with obtuse ends. Length, 0.081 mm; breadth, 0.041. Furrows lanceolate, narrow with alveoli in transverse rows. Central area almost quadrate. Transverse rows of alveoli radiate, 8 in 0.01 mm, forming irregular, longi-

[4] Cleve, The diatoms of Finland (1891) 43-44, pl. 2 fig. 12.

tudinal rows. Differs from variety *ladogensis* in its furrows having two or three alveoli.

DIPLONEIS MARGINESTRIATA Hustedt var. NIPPONICA Skv. Plate 4, fig. 5.

Diploneis marginestriata Hustedt var. *nipponica* Skvortzow, Diatoms from Biwa Lake, Honshu Island, Nippon (1936) pl. 4, fig. 3.

Valve linear-elliptic with cuneate ends. Length, 0.022 mm; breadth, 0.0085. Furrows broad-elliptic, with distinct rows. Central area quadrate; striæ radiate. Differs from the type in its more robust striæ and in the presence of rows on the furrows. This variety is reported from Biwa Lake, Nippon. Common.

DIPLONEIS SUBOVALIS Cleve var. BAIKALENSIS var. nov. Plate 4, fig. 11.

Valve broad-elliptic with rounded ends. Length, 0.039 mm; breadth, 0.026. Furrows broad, central area suborbicular. Median line broad, robust. Transverse rows of alveoli 5 in 0.01 mm. Costæ with double rows of alveoli, 9 to 10 in 0.01 mm, forming irregular longitudinal rows. Differs from the type in its broader valve, more robust costæ, and more distinct alveoli. *Diploneis subovalis* Cleve is known from fresh waters of Paeroa, New Zealand.[3] A related species, *D. pseudovalis* Hustedt, is known from brackish waters. Common.

DIPLONEIS BAIKALENSIS Skv. and Meyer. Plate 4, figs. 2 and 12.

Diploneis baicalensis Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 11, pl. 1, fig. 31.

Valve elliptic with cuneate ends. Length, 0.064 to 0.111 mm; breadth, 0.039 to 0.056. Median line robust. Furrows broad lanceolate-elliptic, with indistinct furrow rows. Central rows with one row of puncta, the middle rows with double rows of puncta, and the end rows with one row of puncta. Central area almost quadrate. Transverse striæ radiate, 4.5 to 7 in 0.01 mm. Common.

DIPLONEIS TURCIDA sp. nov. Plate 4, fig. 9.

Valve elliptic with obtuse ends. Length, 0.059 to 0.073 mm; breadth, 0.025 to 0.032. Median line filiform. Furrows broad-lanceolate, slightly undulate at the middle, with distinct rows of large alveoli. Central area small and orbicular. Transverse rows of alveoli distinct, 5 to 6 in 0.01 mm, forming irregular longitudinal rows. Common.

[3] Cleve, Synopsis of naviculoid diatoms (1894) 1, 96, pl. 1, fig. 27.

DIPLONEIS TURGIDA sp. nov. var. BIPUNCTATA var. nov. Plate 6, fig. 10

Differs from the type in having furrows with double rows of puncta. Length, 0.064 mm; breadth, 0.025. Striæ 6 in 0.01 mm. Alveoli 4.5 in 0.01 mm. Common.

DIPLONEIS LATA sp. nov. Plate 6, fig. 12.

Diploneis elliptica Cleve var. *baikalensis* Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928, 11, pl. 1, fig. 29.

Valve broad-oval or broad-elliptic with obtuse ends. Length, 0.061 to 0.088 mm; breadth, 0.052 to 0.066. Median line short and broad. Furrow robust and broad, closely following the central nodule. Furrow rows covered with large alveoli. Central area suborbicular. Transverse rows of alveoli radiate, 4 in 0.01 mm. Alveoli 4 to 8 in 0.01 mm. Transverse rows of alveoli irregularly anastomosing with a few longitudinal undulating costæ. This is a distinct species, remarkable not only for the broad furrow and large alveoli, but also for its large broad-oval valve.

DIPLONEIS LATA sp. nov. var. PUNCTATA var. nov. Plate 6, fig. 6.

Differs from the type in its punctate central area and in its furrows without alveoli. Length, 0.068 mm; breadth 0.046. Transverse rows of alveoli 5 in 0.01 mm. Alveoli 5 in 0.01 mm. Common.

DIPLONEIS LATA sp. nov. var. MINUTA var. nov. Plate 6, fig. 13.

Diploneis Mauleri Brun var. *baicalensis* Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) II, pl. 1, fig. 33.

Differs from the type in its small valves, lanceolate furrows, and distinct alveoli. Length, 0.03 mm; breadth, 0.02. Transverse rows of alveoli 9 in 0.01 mm. Very common.

STAURONEIS PHŒNICENTERON Ehr. Plate 9, fig. 4b.

Stauroneis phœnicenteron Ehr., Fr. Hustedt, Bacillar. (1930) 205, fig. 404.

Valve lanceolate, gradually tapering from the middle to the subacute ends. Length, 0.107 to 0.196 mm; breadth, 0.02 to 0.035. Striæ radiate, 13 in 0.01 mm. Rare.

STAURONEIS ANCEPS Ehr. var. BAIKALENSIS var. nov. Plate 9, fig. 1c.

Valve lanceolate, subacute. Length, 0.072 mm; breadth, 0.013. Axial area narrow; central area a broad stauros. Striæ radiate, 13 to 14 in 0.01 mm. Puncta 20 to 22 in 0.01 mm. Differs from the variety *hyalina* Brun and Perag. in its unshortened median striæ. Rare.

STAURONEIS BAIKALENSIS sp. nov. Plate 7, fig. 3

Valve elliptic-lanceolate with subrostrate ends. Length, 0.073 mm; breadth, 0.02. Median line filiform with small, comma-shaped, terminal fissures. Axial area narrow-linear; central area widened and dilated. Striæ curvate and radiate, punctate, 12 in 0.01 mm. Rare.

Genus NAVICULA Bory

Naviculæ orthostichiæ Cleve

NAVICULA CUSPIDATA Kütz. Plate 7, fig. 5.

Navicula cuspidata Kütz., Fr. Hustedt, Bacillar. (1930) 268, fig. 433.

Valve rhombic-lanceolate, gradually tapering from the middle to the subacute ends. Length, 0.156 mm, breadth, 0.03. Axial and central areas linear and narrow. Striæ 15 in 0.01 mm. Rare.

Naviculæ mesoleiæ Cleve

NAVICULA ARGUENS sp. nov. Plate 7, fig. 28.

Valve lanceolate with attenuate ends. Length, 0.017 mm; breadth, 0.0042. Median line with indistinct terminal fissures. Central nodules distinct. Axial and central areas narrow-lanceolate. Striæ radiate, not lineate, 12 in 0.01 mm. This small diatom seems to be a distinct species, closely related to *N. Hustedtii* Krasske, *N. disjuncta* Hustedt, and others.

NAVICULA CONFERVACEA Kütz. var. BAIKALENSIS var. nov. Plate 7, fig. 6.

Valve elliptic lanceolate with broad rounded ends. Length, 0.018 mm; breadth, 0.0076. Axial and central areas narrow-lanceolate. Striæ slightly radiate, 25 in 0.01 mm, finely punctate. Differs from the type in its axial and central areas and finely punctate striæ. The type is known from tropical regions.

Naviculæ bacillares Cleve

NAVICULA AMERICANA Ehr. Plate 10, fig. 1.

Navicula americana Ehr., Fr. Hustedt, Bacillar. (1930) 280, fig. 464.

Valve elliptic with cuneate ends. Length, 0.054 mm; breadth, 0.018. Striæ radiate, 11 (middle), or 15 (ends), in 0.01 mm. Rare. Common in fresh waters.

NAVICULA BACILLUM Ehr. Plate 8, fig. 17; Plate 9, fig. 14.

Navicula bacillum Ehr., Fr. Hustedt, Bacillar. (1930) 280, fig. 465a.

Valve linear-elliptic with broad ends. Length, 0.042 to 0.057 mm; breadth, 0.015 to 0.02. Median line in a thick siliceous rib. Striæ 12 (middle), or 15 to 17 (ends), in 0.01 mm. Very common.

NAVICULA PUPULA Kütz. var. CAPITATA Hust. Plate 8, fig. 32.

Navicula pupula Kütz. var. *capitata* Hust., Fr. Hustedt, Bacillar. (1930) 281, fig. 467c.

Valve lanceolate with capitate ends. Length, 0.03 mm; breadth, 0.0068. Striæ radiate 22 (middle), or 26 to 28 (ends), in 0.01 mm. Central area quadrate. Rare.

NAVICULA PUPULA Kütz. var. BAIKALENSIS var. nov. Plate 8, fig. 31.

Valve linear-lanceolate, attenuate towards the obtuse ends. Length, 0.044 mm; breadth, 0.0068. Striæ radiate, 15 (middle) or 20 (ends), in 0.01 mm. Differs from the type in its more robust and broader valve, from variety *rectangularis* (Greg.) Grun. in its more lanceolate valve.

NAVICULA SUBHAMULATA Grun. var. PARALLELA Skv. Plate 9, fig. 37.

Navicula subhamulata Grun. var *parallela* Skvortzow, Diatoms from Biwa Lake, Honshu Island, Nippon (1936) pl. 6, fig. 11.

Valve broad-linear with parallel margins and broad rounded ends. Length, 0.016 mm; breadth, 0.005. Striæ in the middle more distinct, 21 in 0.01 mm. Median line straight. Uncommon. Reported from Biwa Lake, Nippon.

NAVICULA SUBHAMULATA Grun. var. GIBBOSA var. nov. Plate 9, fig. 2.

Differs from the type in its slightly undulate middle part. Length, 0.018 mm; breadth, 0.005. Striæ more distinct in the middle, 21 in 0.01 mm. Variety *undulata* Hust. differs from variety *gibbosa* in its triundulate valves.

NAVICULÆ DECIPIENTES Cleve

NAVICULA FLUENS Hust. var. BAIKALENSIS var. nov. Plate 9, fig. 34.

Valve elliptic-lanceolate with attenuate, obtuse ends. Length, 0.017 mm; breadth, 0.005. Axial and central areas narrow-linear. Striæ slightly radiate, 18 to 19 in 0.01 mm, not punctate. Differs from the type in its more robust striæ. The type is known from Holstein, Germany.*

NAVICULA FLUENS Hust. var. SUBROSTRATA var. nov. Plate 9, fig. 5.

Valve lanceolate-elliptic with subrostrate ends. Length, 0.017 mm; breadth, 0.005. Striæ slightly radiate, 15 in 0.01 mm, in the middle part not shorter. Median line robust and distinct.

NAVICULA CRUCICULA (W. Smith) Donkin var. OBTUSATA Grun. Plate 9, fig. 35.

Navicula cruciculo (W. Smith) Donkin var. *obtusata* Grun., Cleve, and Grunow, Beiträge zur Kenntniss der Arctischen Diatomeen (1880) pl. 2, fig. 37.

*Hustedt, Bacillar. (1930) 285, fig. 474.

Valve broad-lanceolate with attenuate and broad rounded ends. Length, 0.03 mm; breadth, 0.007 Striæ radiate, 14 (middle) or 18 (ends), in 0.01 mm. Axial and central areas narrow. Known in brackish water. Uncommon.

NAVICULA SILICEA sp. nov. Plate 8, fig. 18.

Valve slightly siliceous, lanceolate with attenuate and capitate ends Length, 0.019 mm; breadth, 0.0036. Median line filiform Axial and central areas and striæ indistinct. This species is akin to *N. subtilissima* Cleve.

NAVICULÆ MINUSCULÆ CLEVE

NAVICULA DELICATULA sp. nov. Plate 7, fig. 13; Plate 9, fig. 19.

Valve linear-lanceolate, slightly gibbous in the middle and gradually attenuate towards the ends. Length, 0.025 to 0.026 mm; breadth, 0.005 to 0.006. Axial and central areas linear, narrow. Striæ slightly radiate, more distinct in the middle, 20 to 22 (middle), or 28 (end), in 0.01 mm. Terminal fissures distinct. This little diatom is akin to *N. densestriata* Hust.[7]

NAVICULÆ MINUSCULÆ CLEVE

NAVICULA ATOMUS (Naegel) Grun. Plate 9, fig. 21

Navicula atomus (Naegeli) Grun. FR. HUSTEDT, Bacillar. (1930) 238, fig. 484

Valve minute, elliptic with broad ends. Length, 0.0085 mm; breadth, 0.0034. Striæ slightly radiate, 22 in 0.01 mm. Axial and central areas very narrow. Striæ more robust than in the type. Rare.

NAVICULÆ HETEROSTICHÆ CLEVE

NAVICULA ANTIQUA sp. nov. Plate 10, fig. 5.

Valve elliptic-lanceolate with slightly attenuate and broad rounded ends. Length, 0.119 mm; breadth, 0.03. Median line robust, filiform, with indistinct terminal fissures. Central pores with short straight projections. Axial area narrow, with a distinct, broad, terminal nodule or area; central area slightly enlarged. Striæ radiate, curved, 18 in 0.01 mm, from both sides of the valve, alternately longer and shorter. Striæ punctate. Puncta 18 to 20 in 0.01 mm. A distinct species akin to *N. anaandrinoides* Hust., from Columbia River, North America. A fresh-water fossil.[8]

[7] Hustedt, op. cit. 238, fig. 485.
[8] Schmidt, Atlas Diatom. (1930) pl. 370, fig. 3.

NAVICULA CINGENS sp. nov. Plate 6, fig. 24.

Valve broad elliptic-lanceolate. Length, 0.047 mm; breadth, 0.025. Median line filiform, robust, with indistinct terminal fissures. Axial area linear, central area elliptic. Striæ strongly radiate, punctate, 17 in the middle, 22 at the ends, in 0.01 mm. Puncta 25 to 30 in 0.01 mm. From both sides of the valve the marginal striæ are interrupted by an irregular longitudinal line. This species is related to *N. antiqua* sp. nov.

NAVICULÆ LINEOLATÆ CLEVE

NAVICULA COSTULATA Grun. Plate 3, fig. 11.

Navicula costulata Grun., Fr. Hustedt, Bacillar. (1930) 293, fig. 505.

Valve rhombic-lanceolate with subacute ends. Length, 0.023 mm; breadth, 0.005. Striæ radiate throughout, 6 in 0.01 mm. This species is known from European lakes.

NAVICULA COSTULATA Grun. var. BAIKALENSIS var. nov. Plate 7, fig. 4.

Differs from the type in its broad rhombic valves. Length, 0.019 mm; breadth, 0.0085. Striæ 9 in 0.01 mm, lineate. Rare.

NAVICULA COSTULOIDES sp. nov. Plate 7, fig. 27.

Valve lanceolate with attenuate ends. Length, 0.037 mm; breadth, 0.009. Striæ radiate, not lineate, divergent at the middle and convergent at the ends, more robust in the middle, 6 (middle) or 9 (ends) in 0.01 mm. Median line filiform with comma-shaped terminal fissures and distinct central nodules. Axial area narrow, central area broad. A distinct species that agrees with *N. cincta* (Ehr.) Kutz.

NAVICULA CRYPTOCEPHALA Kutz. Plate 9, figs. 7 and 15.

Navicula cryptocephala Kütz., Fr. Hustedt, Bacillar. (1930) 295, fig. 496.

Valve lanceolate with attenuate ends. Length, 0.0187 to 0.025 mm; breadth, 0.0058 to 0.0068. Striæ radiate and slightly convex at the ends, 14 to 15 in 0.01 mm. Common.

NAVICULA CRYPTOCEPHALA Kutz. var. EXILIS (Kütz.) Grun. Plate 7, fig. 25.

Navicula cryptocephala Kütz. var. *exilis* (Kütz.) Grun., Fr. Hustedt, Synopsis (1880-81) 85, pl. 8, fig. 2

Valve slightly elongate. Length, 0.021 mm, breadth, 0.005. Striæ about 20 in 0.01 mm. Our specimens are somewhat longer than the type. Rare.

NAVICULA CRYPTOCEPHALA Kutz. var. VENETA (Kütz.) Grun. Plate 9, fig. 8.

Navicula cryptocephala Kütz. var. *veneta* (Kütz.) Grun., Fr. Hustedt, Bacillar. (1930) 295, fig. 497a.

Valve lanceolate with short attenuate ends. Length, 0.015 mm, breadth, 0.0043. Striæ radiate, 15 in 0.01 mm. Rare.

NAVICULA RHYNCHOCEPHALA Kütz. Plate 6, fig. 6.

Navicula rhynchocephala Kütz., Fr. Hustedt, Bacillar. (1930) 296, fig. 501.

Valve lanceolate with attenuate and long ends. Length, 0.047 mm; breadth, 0.009. Median line filiform. Axial area narrow, central area broad. Striæ radiate throughout, lineate, 10 in 0.01 mm. Middle striæ more distinct. Uncommon. Known in fresh and brackish waters

NAVICULA RHYNCHOPHALA Kütz. var. TENUA Skv. Plate 8, figs. 13 and 49.

Navicula rhynchocephala Kütz. var. *tenua* Skvortzow, Diatoms from Chengtu, Szechwan, West China, pl. 3, fig. 12; pl. 4, fig. 14

Valve lanceolate with long ends. Length, 0.023 to 0.029 mm; breadth, 0.006 to 0.0068. Striæ 15 in 0.01 mm. Known from Chentu, western China.

NAVICULA LANCEOLATA (Agardh) Kütz. Plate 7, fig. 18

Navicula lanceolata (Agardh) Kütz., Fr. Hustedt, Bacillar. (1930) 305, fig. 540.

Valve lanceolate, gradually attenuate towards the ends. Length, 0.034 mm; breadth, 0.0068. Striæ radiate, lineate, 12 in 0.01 mm. Common.

NAVICULA LANCEOLATA (Agardh) Kütz. var. CYMBULA (Donkin) Cleve. Plate 8, fig. 38.

Navicula cymbula Donkin, Van Heurck, Synopsis (1880–81) pl. 7, fig. 82.

Differs from the type in its more robust striæ. Length, 0.052 mm, breadth, 0.007. Striæ 8 in 0.01 mm. Common.

NAVICULA LANCEOLATA (Agardh) Kütz. var. TENUIROSTRIS var. nov. Plate 8, fig. 28.

Valve lanceolate with elongate subrostrate ends. Length, 0.037 mm; breadth, 0.0068. Axial area narrow, central area broad. Striæ radiate throughout, distinctly lineate, 7 to 8 in the middle, 12 at the ends, in 0.01 mm. Differs from the type in its elongate and subrostrate ends. Uncommon.

NAVICULA GRACILIS Ehr. Plate 1, fig. 14.

Navicula gracilis Ehr., Fr. Hustedt, Bacillar. (1930) 299, fig. 514.
Navicula vulpina Kütz. var. *oregonica* Cleve fo. *baicalensis* Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 19, pl. 1, fig. 62.

Valve linear-lanceolate with long, obtuse ends. Length, 0.068 to 0.076 mm; breadth, 0.0085 to 0.009. Median line filiform with distinct, comma-shaped, terminal fissures. Axial area narrow; central area orbicular. Striæ radiate, divergent in the middle, and convergent at the ends. Striæ lineate, 10 to 11 in 0.01 mm. Infrequent.

NAVICULA ROSTELLATA Kütz. Plate 8, figs. 31; Plate 9, fig. 23.

Navicula rostellata Kütz., Fr. Hustedt, Bacillar. (1930) 207 fig. 502.

Valve narrow-elliptic-lanceolate with subrostrate ends. Length, 0.044 to 0.059 mm; breadth, 0.0085 to 0.009. Axial area indistinct, narrow; central area orbicular with a siliceous rib from one side of the median line. Striæ radiate, lineate, 10 to 11 in 0.01 mm, convergent at the ends. Common.

NAVICULA PSEUDOGRACILIS sp. nov. Plate 9, figs. 20 and 21.

Valve linear-lanceolate with parallel margins, attenuate at the subacute ends. Length, 0.051 to 0.064 mm; breadth, 0.0083. Median line filiform with distinct, comma-shaped, terminal fissures, bordered on one or on both sides by a siliceous rib. Axial area very narrow, indistinct, central area widened or truncate outward. Striæ slightly radiate, little divergent in the middle and convergent at the ends, 11 in 0.01 mm. Differs from *N. gracilis* Ehr. in its lineate striæ and distinct siliceous rib on one or both sides of the median line. Uncommon.

NAVICULA HASTA Pant. Plate 7, figs. 11 and 19.

Navicula hasta Pant., Fr. Hustedt, Bacillar. (1930) 206, fig. 541.

Valve lanceolate, gradually tapering to the subacute ends. Length, 0.07 to 0.093 mm; breadth, 0.012 to 0.017. Median line filiform, straight, with small, comma-shaped, terminal fissures. Striæ radiate throughout, lineate, 9 to 10 in 0.01 mm. Differs from the type in its gradually attenuate and not slightly undulate ends. Uncommon.

NAVICULA MAGNA sp. nov. Plate 8, figs. 25 and 27; Plate 9, fig. 24.

Pinnularia baicalensis Skvortzow and Meyer, Contribution to the diatoms of Baika. Lake (1928) 23, pl. 2, fig. 52.

Valve linear-lanceolate, gradually tapering from the middle to the subacute ends. Length, 0.079 to 0.18 mm; breadth, 0.012 to 0.019. Median line filiform with large, distinct, fork-shaped, terminal fissures. Central pores distinct. Axial and central areas broad-lanceolate, about half of the valve diameter. Striæ robust, lineate, radiate throughout, 5 to 8 in 0.01 mm, alternately

longer and shorter along both sides of the valve. A distinct form common in Baikal.

NAVICULA MAGNA sp. nov. var. LANCEOLATA var. nov. Plate 3, fig. 28.

Differs from the type in its more attenuate ends. Length, 0.105 mm; breadth, 0.013. Striæ lineate, not so irregularly interrupted as in the type, 5 to 6.5 in 0.01 mm. Axial and central areas broad lanceolate. Common.

NAVICULA MAGNA sp. nov. var. CURTA var. nov. Plate 16, fig. 14.

Pinnularia hemiptera Kütz. var. *baicalensis* Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 22, pl. 3, fig. 71.

Differs from the type in its shorter and broader valves. Length, 0.153 mm; breadth, 0.03. Striæ 5 in 0.01 mm. Rare.

NAVICULA GASTRUM Ehr. Plate 7, fig. 34.

Navicula gastrum Ehr., Fr. Hustedt, Bacillar. (1930) 305, fig. 537.

Valve broad-elliptic with short subrostrate ends. Length, 0.042 mm, breadth, 0.015. Median line straight, fine. Terminal fissures indistinct. Axial area narrow, central area broad. Striæ radiate, not lineate, 11 in 0.01 mm; in the middle part alternately longer and shorter. Rare.

NAVICULA VULPINA Kütz. Plate 3, fig. 6.

Navicula vulpina Kütz., A. Schmidt, Atlas Diatom. (1876) pl. 47, figs. 53, 54.

Valve lanceolate, gradually tapering from the middle to the obtuse ends. Length, 0.068 mm; breadth, 0.012. Striæ radiate, lineate, convergent at the ends, 10 to 11 in 0.01 mm. Common.

NAVICULA VULPINA Kütz. var. OREGONICA Cleve. Plate 7, fig. 24.

Navicula viridula Kütz., A. Schmidt, Atlas Diatom. (1876) pl. 47, figs. 55, 56.

Differs from the type in its more lanceolate valves. Length, 0.074 mm; breadth, 0.013. Striæ 9 in 0.01 mm. Known as a fossil from Oregon, North America.

NAVICULA PEREGRINA (Ehr.) Kütz. Plate 7, fig. 8; Plate 8, fig. 19.

Navicula peregrina Ehr., A. Schmidt, Atlas Diatom. (1876) pl. 47, fig. 66.

Valve lanceolate with broad, obtuse ends. Length, 0.074 to 0.076 mm, breadth, 0.017 to 0.019. Striæ radiate, robust, lineate, 6 in 0.01 mm in the middle part, and 9 in 0.01 mm at the ends. Known from brackish waters. Uncommon.

NAVICULA PEREGRINA (Ehr.) Kütz. var. KEFFINGENSIS (Ehr.) Cleve? Plate 6, fig. 9.

Valve 0.049 mm in length, 0.01 in breadth. Our valves are not similar to Schmidt's figures.[9]

NAVICULA LACUS BAIKALI Skv. and Meyer Plate 7, fig. 23; Plate 9, fig. 3.

Navicula Lacus Baikali Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 20, pl. 1, fig. 59.

Valve lanceolate with obtuse ends. Length, 0.074 to 0.136 mm; breadth, 0.02 to 0.03. Axial area narrow; central area orbicular. Median line straight, with distinct, comma-shaped, terminal fissures and distinct central pores. Striæ robust, slightly radiate throughout and not convergent at the ends, 6 to 10 in 0.01 mm, distinctly lineate. Striæ on both sides of the median line are crossed by a narrow, blank area. A distinct species closely related to *N. Hauerí* Grun., which is distinguished only by convergent striæ in the ends of the valves and the presence of lunate markings near the central nodule. *Navicula Hauerí* Grun. is known as a brackish-water fossil from Hungary (Dubravica, Bory).[10] Another related species, *N. Phi* Cleve, is a marine form from Seychelles.[11]

NAVICULA LACUS BAIKALI Skv. and Meyer var. SIMPLEX Skv. and Meyer. Plate 9, fig. 8; Plate 10, fig. 7.

Navicula Lacus Baikali Skv. and Meyer var. *simplex* Skvortzow and Meyer, Contribution to the diatoms from Baikal Lake (1928) 20, pl. 1, fig. 70.

Differs from variety *baikalensis* in its small valves with a distinct narrow blank area or with only few interrupted striæ. Length, 0.049 mm; breadth, 0.015. Striæ 7 to 8 in 0.01 mm. Common.

NAVICULA LACUS BAIKALI Skv. and Meyer var. LANCEOLATA var. nov. Plate 7, fig. 1; Plate 8, fig. 12.

Navicula Lacus Baikali Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 20, pl. 1, fig. 68.

Valve lanceolate with long, subacute ends. Length, 0.037 to 0.096 mm; breadth, 0.017 to 0.024. Striæ 7 to 8 in 0.01 mm, crossed by a broad blank area. Differs from the type in its long acute ends. Common.

[9] Schmidt, op. cit. (1876) pl. 47, figs. 61, 62.

[10] Grunow, Beiträge zur Kenntniss der Fossilen Diatom. Österreich-Ungarns (1862) 143, pl. 30, fig. 48. Pantocsek, Beiträge zur Kenntniss der Fossilen Bacil. Ungarns (1903) 3, pl. 8, fig. 135.

[11] Cleve, Synopsis of the naviculoid Diatoms (1895) 2, 24, pl. 1, fig. 24.

NAVICULA TUSCULA (Ehr.) Grun. Plate 8, fig. 3.

Navicula tuscula (Ehr.) Grun., A. SCHMIDT, Atlas Diatom. (1911) pl. 272 figs 24-27, FR. HUSTEDT, Bacillar. (1930) 308, fig. 552.

Valve elliptic-lanceolate with subrostrate ends. Length, 0.049 mm, breadth 0.015. Median line filiform or slightly sigmoid in the middle part. Axial area very narrow; central area oblique and broad of different size. Striæ radiate, 10 to 12 in 0.01 mm, of longitudinal puncta, forming irregular longitudinal rows. Common.

NAVICULA MEYERI sp. nov. Plate 7, fig. 27; Plate 9, figs. 21 and 42.

Valve lanceolate gradually tapering to the subacute ends. Length, 0.032 to 0.081 mm; breadth, 0.013 to 0.022. Median line very distinct with small, comma-shaped, terminal fissures and curved in the middle part. Axial area narrow; central area suborbicular. Striæ distinct, 10 to 12 in 0.01 mm, punctate. Puncta elongate, forming irregular longitudinal rows on both sides of the valve. Differs from *N. tuscula* (Ehr.) in its curved median line, suborbicular central area, and striæ mostly punctate and not elongate. Named in honor of Prof. K. I. Meyer, of Moscow.

NAVICULA ANGLICA Ralfs. Plate 9, figs. 18, 19, 22.

Navicula anglica Ralfs, FR. HUSTEDT, Bacillar. (1930) 303, figs. 530–531.

Valve elliptic with subrostrate ends. Length, 0.025 to 0.029 mm; breadth, 0.0085 to 0.012. Median line slightly arcuate. Axial area linear, narrow; central area small, suborbicular. Striæ radiate throughout, not lineate or finely lineate, 8 to 12 in 0.01 mm. A common fresh-water diatom.

NAVICULA ANGLICA Ralfs var. SUBSALSA Grun. Plate 9, fig. 47.

Navicula anglica Ralfs var. *subsalsa* Grun., VAN HEURCK, Synopsis (1880–1885) pl. 8, fig. 31.

Differs from the type in its more obtuse ends. Length, 0.023 mm; breadth, 0.0085. Striæ radiate throughout, not lineate, 9 in 0.01 mm. Known from slightly brackish water. Rare.

NAVICULA EXIGUA (Greg.) O. Müll. Plate 8, fig. 2.

Navicula exigua (Greg.) O. MÜLL., FR. HUSTEDT, Bacillar. (1930) 305, fig. 533.

Valve elliptic-lanceolate with rostrate ends. Length, 0.025 mm; breadth, 0.0085. Median line straight. Axial area linear, narrow; central area orbicular. Striæ radiate, not lineate, in the middle alternately longer and shorter, 12 in 0.01 mm. Rare.

NAVICULA PLACENTULA (Ehr.) Grun. Plate 5, fig. 2.

Navicula placentula (Ehr.) Grun., Fr. HUSTEDT, Bacillar (1930) 303, fig. 532.

Valve elliptic-lanceolate with cuneate ends. Length, 0.052 mm; breadth, 0.02. Striæ radiate, robust, not lineate, 6 in 0.01 mm. Differs from the type in its nonlineate striæ. Common.

NAVICULA PLACENTULA (Ehr.) Grun. fo. JENISSEYENSIS (Grun.) Meister. Plate 7, fig. 34; Plate 8, fig. 36.

Navicula gastrum var. *jenisseyensis* Grun., CLEVE and GRUNOW, Beiträge zur Kenntniss der Arctischen Diatomeen (1880) 31, p. 1 fig. 28.

Valve lanceolate with attenuate ends. Length, 0.04 to 0.102 mm; breadth, 0.012 to 0.020. Median line straight with small, comma-shaped, terminal fissures and distinct central pores. Axial area narrow; central area orbicular. Striæ radiate, fine, not lineate, 6 to 7 in 0.01 mm. According to Grunow the type specimens have very fine lineate striæ. Infrequent.

NAVICULA PLACENTULA (Ehr.) Cleve fo. ROSTRATA A. Meyer. Plate 9, figs. 30, 44, and 46.

Navicula placentula (Ehr.) Cleve fo. *rostrata* A. Meyer, Fr. HUSTEDT, Bacillar. (1930) 304, fig. 533.

Two forms were recognized: (*a*) Valve short elliptic with subrostrate ends. Length, 0.027 mm; breadth, 0.012. Striæ 9 in 0.01 mm, lineate (Plate 5, fig. 34). (*b*) Valve elliptic with subrostrate ends. Length, 0.031 to 0.056 mm; breadth, 0.017 to 0.036. Striæ not lineate, 7 to 9 in 0.01 mm (Plate 5, figs. 35 and 39). Both forms are common.

NAVICULA SUBPLACENTULA Hust. var. BAIKALENSIS var. nov. Plate 9, fig. 31.

Valve lanceolate with subacute ends. Length, 0.079 mm; breadth, 0.029. Median line filiform with comma-shaped terminal fissures. Axial area linear; central area suborbicular. Striæ radiate throughout, 4 in 0.01 mm. Striæ double punctate. A distinct species with double punctate, robust striæ, known from fresh water of Tanganyika Lake, Africa[17] The Baikal form differs from the type in its more elliptic valves and in the terminal part of its median line.

NAVICULA ANNULANA Grun. var. BAIKALENSIS var. nov. Plate 8, fig. 17

Valve rhomboidal and obtuse. Length, 0.034 mm; breadth, 0.015. Median line filiform, straight, with small, comma-shaped, terminal fissures. Central nodules distinct. Axial area narrow,

[17] Schmidt, Atlas Diatom. (1930) pl. 370, fig. 7.

linear, central area suborbicular. Striæ strongly radiate, in the middle part alternately longer and shorter, not lineate, 10 in 0.01 mm. Differs from the type in its smaller valves and its broader appearance. *Navicula annulata* Grun. is known from Demarara River, South America.[13]

NAVICULA MENISCULUS Schumann. Plate 7, fig. 39

Navicula menisculus Schumann, F.R. Hustedt, Bacillar. (1930) 301, fig. 517.

Valve elliptic with acute ends. Length, 0.034 mm; breadth, 0.01. Striæ radiate, lineate, 10 in 0.01 mm. Rare.

NAVICULA SUBOCCULATA Hust. var. UNILATERALIS var. nov. Plate 7, fig. 12.

Valve linear with parallel margins and broad rounded ends. Axial area narrow; central area a broad rectangular fascia, larger on one side of the valve than on the other. Striæ 21 to 22 in 0.01 mm. Differs from the type in its smaller size, coarser striæ, and in the central area. *Navicula suboccolata* Hust. is known from the bottoms of European lakes.[14]

NAVICULA SUBOCCULATA Hust. var. BAIKALENSIS var. nov. Plate 7, fig. 10.

Smaller than the type. Length, 0.0068 mm; breadth, 0.0029. Striæ about 30 in 0.01 mm. Rare.

NAVICULA UNIPUNCTATA sp. nov. Plate 8, fig. 10.

Valve lanceolate with acute ends. Length, 0.037 mm; breadth, 0.015. Median line straight with small, comma-shaped, terminal fissures. Axial area narrow; central area broad. Striæ radiate, not lineate, in the middle part alternately longer and shorter, 8 in 0.01 mm, with an isolated punctum between the central pores. This is a distinct species and does not belong to *Cymbella*.

NAVICULA PARADOXA sp. nov. Plate 8, fig. 4.

Valve elliptic-lanceolate with subrostrate ends. Median line filiform with indistinct, terminal fissures. Axial and central areas broad-lanceolate, about one-third of the valve breadth. Length, 0.025 mm; breadth, 0.012 Striæ robust, compact, not lineate, slightly radiate, 8 in 0.01 mm, with more distinct and thickened axial and central areas. A distinct species.

NAVICULA GRANULIFERA sp. nov. Plate 6, fig. 1.

Valve elliptic-lanceolate with slightly subrostrate ends. Length, 0.056 mm; breadth, 0.017. Median line straight, en-

[13] Cleve, Synopsis of navicuioid Diatoms (1895) 2, 33, pl 1, fig. 38.
[14] Hustedt, Bacillar. (1930) 307, fig. 516

larged in the middle part, with distinct, comma-shaped, terminal fissures and distinct central nodules. Axial area lanceolate; central area broader. Striæ radiate, not punctate, 8 in 0.01 mm. Between striæ distinct puncta in two or three irregular longitudinal lines. A peculiar form. Uncommon in Baikal.

NAVICULA DELICATULA sp. nov. Plate 8, fig. 12.

Valve lanceolate, gradually tapering from the middle towards the subacute ends. Length, 0.041 mm; breadth, 0.0085. Median line filiform with indistinct terminal fissures. Axial area narrow; central area a broad stauros. Striæ radiate, not lineate, 15 in 0.01 mm. A delicate, slightly siliceous species. Uncommon in Baikal.

NAVICULA ACUTA sp. nov. Plate 8, fig. 24.

Valve lanceolate, gradually tapering towards the acute ends. Length, 0.047 mm, breadth, 0.017. Median line filiform with indistinct terminal fissures. Axial area narrow, linear; central area broad, quadrate. Striæ radiate throughout, 12 to 13 in 0.01 mm, composed of minute indistinct puncta. A species connected with *N. amphibola* Cleve.

NAVICULA WISLOUCHII Skv. and Meyer. Plate 9, fig. 1.

Navicula Wislouchii Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 20, pl. 1, fig. 72.

Valve linear-rectangular with rostrate ends. The middle part somewhat constricted. Length, 0.064 to 0.091 mm; breadth, 0.02 to 0.023. Axial area linear; central area elliptic. Median line filiform, robust with comma-shaped fissures. Central pore distinct. Striæ slightly curved, radiate, 9 to 12 in 0.01 mm. Striæ distinctly punctate, puncta 9 in 0.01 mm, forming irregular, longitudinal, undulating costæ. A species akin to *N. scoliopleuroides* Quint known from hot springs near Budapest.

NAVICULA WERESTSCHAGINI Skv. and Meyer. Plate 7, fig. 5; Plate 10, fig. 2.

Navicula Wereststchagini Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 20, pl. 1, fig. 64.

Valve lanceolate-elliptic with attenuate, subacute ends. Length, 0.056 to 0.103 mm; breadth, 0.027 to 0.034. Median line robust, enlarged in the middle part with comma-shaped terminal fissures and distinct central nodules. Axial area narrow, indistinct; central area suborbicular. Striæ radiate throughout, punctate, 5 to 6 in 0.01 mm. Puncta very distinct, 5 to 7.5 in 0.01 mm, arranged in irregular longitudinal rows.

A large and distinct species akin to many large punctate forms; for instance, *N. Schulzii* Kain. and var. *californica* Cleve, known as a fossil from Atlantic City, New Jersey, and from San Pedro, California [10]

NAVICULA LACUSTRIS Greg. Plate 1, fig. 3 Plate 18, fig. 5.

Navicula lacustris Greg., CLEVE Diatoms of Finland (1891) 34, pl. 2 fig. 14.

Valve lanceolate with subrostrate ends. Length, 0.059 to 0.061 mm; breadth, 0.02 to 0.022. Median line filiform with comma-shaped terminal fissures Axial area narrow; central area suborbicular Striæ radiate, punctate, 11 to 12 in 0.01 mm. The marginal puncta are coarser, the puncta approaching axial area are broader and disposed in irregular longitudinal ribs. Common.

NAVICULA LACUSTRIS Greg. var. ELONGATA Skv and Meyer

Navicula lacustris Greg. var. *elongata* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 18, pl. 1, fig. 31.

Valve longer and broader. Length, 0.09 mm; breadth, 0.022. Striæ 8 in 0.01 mm Rare

NAVICULA LACUSTRIS Greg. var. BAIKALENSIS var. nov. Plate 7 fig. 21.

Differs from the type in its broader axial and central areas and more robust striæ Length, 0.056 mm; breadth, 0.022. Axial area broad; central area orbicular. Striæ radiate, punctate, 6 in 0.01 mm. Puncta 15 in 0.01 mm. Infrequent.

NAVICULA SCUTELLOIDES W. Smith var. BAIKALENSIS var. nov. Plate 9, fig. 48.

Differs from the type and variety *minutissima* Cleve in its suborbicular valves with obsolete striæ. Length, 0.01 mm; breadth, 0.0078. Striæ not punctate, 18 to 20 in 0.01 mm. *Navicula scutelloides* and variety *minutissima* Cleve are reported from fresh and brackish waters.[10]

NAVICULA TORNEENSIS Cleve var. ABOENSIS Cleve. Plate 5, fig. 37, Plate 8, fig. 41 Plate 9, fig. 13 and 42

Navicula torneensis Cleve var *aboensis* CLEVE, Diatoms of Finland (1891) 33, pl. 2, fig. 7; WISLOUCH and KOLBE, Beiträge zur Diatomeenflora des Ongega-sees (1927) 45, pl. fig. 9

Diploneis Mauleri Brun. var, *borealensis* Cleve fo. *baicalensis* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) pl. 1, fig. 25.

[9] Pantocsek, Beiträge zur Kenntnis der Fossilen Bacillarien Ungarns (1893) 3, pl. 24 fig. 481

[10] P. Cleve, Synopsis navicuoid Diatoms (1895) 2, 40; P. Cleve, Diatomaceer fram Grönland och Argentinska republiken (1881) 12, pl. 15, fig. 10.

Valve elliptic, minute with broad rounded ends. Length, 0.0085 to 0.021 mm; breadth, 0.005 to 0.009. Median line filiform with indistinct terminal fissures. Axial and central areas narrow-lanceolate. Striæ distinctly punctate, slightly radiate throughout, 11 to 12 in 0.01 mm. Puncta 12 in 0.01 mm. The first row of puncta, opposite the median line, is interrupted from both sides with a longitudinal blank band. A distinct species very common in Baikal Lake, in Finland, and in Onega Lake of northern Europe.

NAVICULA AMPHIBOLA Cleve var. CERTA var. nov. Plate 3, fig. 4.

Valve elliptic-lanceolate with cuneate ends. Length, 0.037 mm; breadth, 0.028. Median line straight. Axial area narrow; central area widened and truncate outward. Striæ strongly radiate, punctate, 7 in 0.01 mm. Puncta 10 in 0.01 mm. Differs from the type in its shorter valves. Rare.

NAVICULA BAICALICA sp. nov. Plate 3, fig. 35; Plate 8, fig. 7.

Valve elliptic-lanceolate with slightly subrostrate ends. Length, 0.049 to 0.081 mm, breadth, 0.0187 to 0.028. Median line straight with distinct, comma-shaped, terminal fissures and distinct central pores. Axial area linear, somewhat dilated to the central area; central area suborbicular. Striæ radiate throughout, punctate, 6 to 7 in 0.01 mm. Puncta 15 to 18 in 0.01 mm. Middle striæ alternately longer and shorter. A species akin to *N. amphibola* Cleve and *N. pumila* W. Smith. Common.

Genus PINNULARIA Ehrenberg

Pinnulariæ parallelistriatæ Fr. Hustedt

PINNULARIA MOLARIS Grun. Plate 11, fig. 1.

Pinnularia molaris Grun., Fr. Hustedt, Bacillar. (1930) 316, fig. 563.

Valve linear-lanceolate with parallel margins and broad ends. Length, 0.051 mm; breadth, 0.0085. Striæ slightly radiate, divergent in the middle and slightly convergent at the ends, 21 in 0.01 mm. Axial area narrow; central area a broad quadrate fascia. Rare.

PINNULARIA LEPTOSOMA Grun. Plate 9, fig. 26.

Pinnularia leptosoma Grun., Fr. Hustedt Bacillar. (1930) 316, fig. 567.

Valve lanceolate, gradually attenuate towards the ends. Length, 0.025 mm; breadth, 0.0042. Striæ radiate, 18 to 20 in 0.01 mm. Central area a broad and long stauros. Known from mountain districts. Rare.

PINNULARIÆ TABELLARIÆ CLEVE

PINNULARIA GIBBA Ehr. var. BAIKALENSIS var. nov. Plate II, fig. 17.

Valve linear-lanceolate with convex middle part and attenuate ends, undulate. Length, 0.085 mm; breadth, 0.01. Median line robust, straight with distinct, comma-shaped, terminal fissures. Axial area dilated to the middle part of the valve, forming a broad transversely truncate stauros. Striæ robust, 8 in 0.01 mm. Differs from the form *subundulata* Mayer in its more robust median line and more convex median part of the valve. Rare.

PINNULARIA PECTINALIS sp. nov. Plate II, fig. 18.

Valve lanceolate with gibbous middle part and elongate broad ends. Length, 0.059 mm; breadth, 0.01. Median line enlarged in the middle part with distinct comma-shaped terminal fissures and oblique central pores. Axial and central areas lanceolate with a siliceous rib on both sides of median line and central pore. Central area a broad quadrate stauros. Striæ radiate without longitudinal bands, 9 in 0.01 mm. A distinct species not closely connected with the others. Common in Baikal.

PINNULARIA PECTINALIS sp. nov. var. ROSTRATA var. nov. Plate II, figs. 21 and 22.

Differs from the type in its broad elliptic-lanceolate valves with rostrate ends. Length, 0.035 mm; breadth, 0.0068 to 0.0085. Striæ 9 to 10 in 0.01 mm, divergent in the middle, and convergent at the ends. Stauros very broad. Common.

PINNULARIÆ MAIORES CLEVE

PINNULARIA MAJOR (Kütz.) Cleve. Plate II, fig. 5.

Pinnularia major (Kütz.) Cleve, FR. HUSTEDT, Bacillar (1930) 331, fig. 614

Valve linear with broad rounded ends. Length, 0.146 mm; breadth, 0.023. Striæ 6 in 0.01 mm. Rare.

PINNULARIA MAJOR (Kütz.) Cleve fo. MINOR fo. nov. Plate II, fig. 19.

Valve linear with obtuse ends. Length 0.102 mm; breadth, 0.0136. Median line oblique, broad with distinct terminal fissures. Axial and central areas broad. Striæ radiate, divergent in the middle and convergent at the ends, 7 in 0.01 mm, with distinct longitudinal bands. Recently found in Argun River, northern Manchuria.

PINNULARIA CRASSA sp. nov. Plate II, fig. 21.

Valve lanceolate-elliptic with slightly attenuate and broad ends. Length, 0.091 mm; breadth, 0.02. Median line robust

with distinct, comma-shaped, terminal fissures. Central nodules large and curved. Axial area narrow-lanceolate; central area suborbicular. Striæ robust, slightly divergent in the middle and convergent at the ends, 7 in 0.01 mm. Striæ without longitudinal bands. A species distinct in its robust striæ and oblique median line. Rare.

PINNULARIÆ BAIKALIÆ Nob.

Three peculiar species of *Pinnularia* found in Baikal Lake have very distinct central pores not known in any representative of the genus *Pinnularia*. The central pores of these diatoms are joined together by a siliceous handle twisted inside of the central nodule. I propose to unite these three new species, *P. Lacus Baikali*, *P. abnormis*, and *P. viridissima*, under a new group, Pinnulariæ Baikaliæ nob.

PINNULARIA LACUS BAIKALI sp. nov. Plate II, figs. 2, 3, and 21.

Pinnularia Pomeranzevi Reich. var. *baikalensis* Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 23, pl. 2, fig. 31.

Valve linear-lanceolate, slightly constricted in the middle and with subrostrate, broad rounded ends. Length, 0.105 to 0.170 mm; breadth, 0.025 to 0.035. Median line broad, slightly sigmoid with distinct, comma-shaped, terminal fissures. Central pores joined together by a siliceous handle twisted inside of the central nodule. Axial area broad, central area forming a stauros, longer on one side of the valve than on the other, or the central area unilaterally interrupted. Striæ robust, slightly divergent in the middle and convergent at the ends, with distinct longitudinal bands. Striæ 5 in 0.01 mm. A distinct variable species known only in Baikal. Very common.

PINNULARIA LACUS BAIKALI sp. nov. var. GIBBOSA var. nov. Plate II, fig. 18.

Valve gibbous in the middle part. Ends subcapitate. Length, 0.132 mm; breadth, 0.025. Striæ 7 in 0.01 mm. Rare.

PINNULARIA LACUS BAIKALI sp. nov. var. LANCEOLATA var. nov. Plate II, fig. 20.

Valve elliptic-lanceolate with subacute ends. Length, 0.142 mm; breadth, 0.03. Striæ 5 in 0.01 mm. Rare.

PINNULARIA LACUS BAIKALI sp. nov. var. LINEARIS var. nov. Plate II, fig. 6.

Valve linear with parallel margins and slightly attenuate ends. Length, 0.221 mm; breadth, 0.03. Striæ 5 in 0.01 mm. Rare.

PINNULARIA ABNORMIS sp. nov. Plate II, fig. 1.

Valve linear-lanceolate, undulate in the middle part, and attenuate towards the obtuse ends. Length, 0.17 mm; breadth,

0.023 Median line curiously enlarged, linear with large, comma-shaped, terminal fissures. Central pores connected by an intermediate siliceous band Axial area indistinct; central area lanceolate Striæ robust, divergent in the middle, and convergent at the ends, 5 to 6 in 0 01 mm, Longitudinal bands distinct A very peculiar *Pinnularia* of a primitive habit. Common.

PINNULARIA VIRIDISSIMA sp nov. Plate 11, fig. 15.

Valve elliptic-lanceolate with obtuse ends Length, 0.074 to 0.10o mm; breadth, 0.015 to 0.022 Median line straight with comma-shaped terminal fissures and with central pores connected by an intermediate siliceous band. Axial area broad; central area orbicular. Striæ radiate divergent in the middle, and convergent at the ends, 7 to 8 in 0.01 mm, with two distinct bands. Rare

AMPHORA OVALIS Kütz. Plate 12, fig. 21.

Amphora ovalis Kütz., Fr. Hustedt, Bacillar (1930) 342, fig 628.

Valve lunate with obtuse ends. Length, 0.047 mm; breadth, 0 025 Dorsal striæ 10 to 11 in 0.01 mm; ventral striæ 11 to 12 in 0.01 mm. Striæ distinctly punctate. Rare.

AMPHORA OVALIS Kütz var PEDICULUS Kütz. Plate 12, fig. 2.

Amphora ovalis Kütz. var. *pediculus* Kutz., Fr. Hustedt, Bacillar. 1930) 343, fig 629

Frustule small, elliptic. Length, 0.022 mm; breadth, 0.009. Valve with globous ventral side. Dorsal striæ 13 to 14, ventral 15, in 0.01 mm. Central area a rectangular fascia. Infrequent.

AMPHORA OVALIS Kütz. fa. GRACILIS (Ehr.) Cleve. Plate 12, fig. 19.

Amphora ovalis Kütz. fo. *gracilis* (Ehr.) Cleve, A. Schmidt, Atlas Diatom (1875) pl. 26, fig 101.

Frustule elliptic with abrupt ends. Length, 0.023 mm; breadth, 0.01. Valve with straight ventral side. Dorsal and ventral striæ 12 in 0.01 mm, distinctly punctate. Rare.

AMPHORA OVALIS Kütz. var. CONSTRICTA var. nov. Plate 12, fig. 17.

Frustule elliptic-rectangular and slightly constricted. Length, 0.034 mm; breadth, 0.012. Striæ distinctly punctate, ventral 12, dorsal 10, in 0.01 mm Rare.

AMPHORA NORMANI Rabh. Plate 12, fig. 5.

Amphora Normani Rabh., Fr. Hustedt, Bacillar. (1930) 343, 344, fig 630.

Valve lunate with triundulate dorsal margin and slightly constricted ventral side. Ends subrostrate. Length, 0.022 mm; breadth, 0.0034. Axial and central areas broad. Striæ only marginal on the dorsal side, 18 in 0.01 mm. Rare.

AMPHORA PERPUSILLA Grun. Plate 12, fig. 22.

Amphora perpusilla Grun., Fr. Hustedt, Bacillar. (1930) 443, fig. 627.

Frustule elliptic with abrupt ends. Length, 0.017 mm; breadth, 0.0068. Striæ 18 in 0.01 mm. Rare.

AMPHORA MONGOLICA Oestrup. Plate 12, fig. 21.

Amphora mongolica OESTRUP, Beiträge zur Kenntnis der Diatomeenflora des Kossogolbeckens in der nordwestlichen Mongolei. Hedwigia 48 (1909) pl. fig. 4.

Valve lunate, arcuate with almost straight ventral margin and acute ends. Median line slightly biarcuate with distinct central pores. Axial and central areas long-lanceolate, surrounded from the dorsal side by a distinct siliceous rib. Length, 0.062 mm; breadth, 0.042. Striæ of dorsal side 9 in 0.01 mm, in the middle part compact; others are formed by longitudinal alveoli in longitudinal lines. Ventral margin with a row of short beads, 9 in 0.01 mm, interrupted in the middle part. A distinct species, known from Kossogol and Baikal Lakes as recently reported by me from western China. Differs from *A. ovalis* Kütz. in the presence of a siliceous rib along the median line from the dorsal side and by compact striæ from the dorsal side near the central area. Common.

AMPHORA MONGOLICA Oestrup var. GRACILIS var. nov. Plate 13, fig. 13.

Valve longer in outline with attenuate ends. Length, 0.149 mm. The interrupted middle part of the ventral side with four short distinct costæ. Striæ of dorsal and ventral margins 9 in 0.01 mm. Infrequent.

AMPHORA MONGOLICA Oestrup var. CORNUTA var. nov. Plate 13, fig. 4.

Differs from the type in the presence of two horn-shaped projections on the middle part of the dorsal side near the central pores. Length, 0.153 mm; breadth, 0.034. Striæ of ventral and dorsal sides 8 in 0.01 mm. Common.

AMPHORA MONGOLICA Oestrup var. CORNUTA fo. INTERRUPTA fo. nov. Plate 13, fig. 7.

Differs from var. *cornuta* in the presence of a broad blank band in the middle part of the dorsal side of the valve. Length,

0.122 mm; breadth, 0.03. Striæ, ventral 6, dorsal 7, in 0.01 mm. Common.

AMPHORA MONGOLICA Oestrup var. BAIKALENSIS Skv. and Meyer. Plate 12, fig. 8.

Amphora mongolica Oestrup var. *baicalensis* Skv. and Meyer, Contribution to the diatoms of Baikal Lake (1928) 37, pl. 3, fig. 170.

Differs from the type in the presence of broad axial and central areas from the dorsal side with isolated puncta near the central pores. Length, 0.088 mm; breadth, 0.02. Striæ 7 in 0.01 mm. Rare.

AMPHORA COSTULATA sp. nov. Plate 12, fig. 1

Valve lunate with long attenuate ends. Length, 0.032 mm; breadth, 0.006. Dorsal side with robust not punctate striæ, 11 in 0.01 mm. Ventral side with a row of short striæ, interrupted in the middle part. A species akin to *A. mongolica* Oestrup. Infrequent.

AMPHORA SIBIRICA Skv. and Meyer. Plate 12, figs. 12, 14, 21, 26, and 27.

Amphora sibirica Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 36–37, pl. 3, fig. 168.

Frustule elliptic with rounded ends. Length, 0.03 to 0.052 mm, breadth, 0.0085 to 0.013. Valve lunate with curved, straight, or slightly gibbous ventral side and broad rounded ends. Median line biarcuate with a siliceous rib on the dorsal side. Dorsal striæ punctate in irregular longitudinal rows. Puncta 9 to 12 in 0.01 mm, with a blank band across the striæ. Ventral side with a row of short striæ, interrupted in the middle part. A species related to *A. oralis* Kütz., but more robust. Very common.

AMPHORA SIBIRICA Skv. and Meyer var. GRACILIS var. nov. Plate 12, fig. 19.

Differs from the type in its more elongate valve. Length, 0.057 mm; breadth 0.0085. Dorsal side with a broad, truncate, outward blank, band. Dorsal striæ 9, ventral 12, in 0.01 mm. Infrequent.

AMPHORA ROTUNDA sp. nov. Plate 12, fig. 13.

Frustule suborbicular with rostrate ends. Length, 0.04 mm, breadth, 0.035. Valve oblique-arcuate with almost straight ventral and arcuate dorsal sides. Median line slightly biarcuate, axial area indistinct with a siliceous rib along the dorsal side of the median line. Dorsal side constricted from two parts, marginal hyaline, and central striate. Striæ distinctly punctate. Central area distinct on the dorsal side with a blank band across

the striæ. Ventral side with a row of short striæ, interrupted in the middle part. A species akin to *A. sibirica* Skv. and Meyer.

AMPHORA DELPHINEA (Bail.) A. Smith. Plate 12 fig. 4.

Amphora delphinea (Bail.) A. Smith, A. Schmidt, Atlas Diatom. (1876) pl. 40, figs. 26, 27.

Frustule slightly siliceous, linear with parallel margins and broad rounded ends. Length, 0.085 mm; breadth, 0.022. Valve linear with oblique ends. Median line arcuate. Central area dilated to a stauros. Terminal fissures indistinct. Striæ almost parallel, 21 in 0.01 mm. Differs from the type in its more robust striæ. Known from tropical fresh water, Demerara River of South America; *A. delphinea* var. *minor* Cleve is known from Crane Pond, North America, from Demerara River of South America, and from Kizaki Lake, Nippon.

AMPHORA OBTUSA Greg. var. BAIKALENSIS var. nov. Plate 12, figs. 20 and 21.

Frustule elliptic-rectangular with obtuse ends, twice as long as broad. Length, 0.042 mm; breadth, 0.022. Valve elliptic-linear, lunate and obliquely rounded. Median line arcuate. Axial area indistinct; central area distinct. Dorsal side with three robust, siliceous, marginal interruptions, one in the middle, two others on the ends. Striæ almost parallel, very fine, 18 in 0.01 mm. Striæ of ventral side divergent in the middle, convergent at the ends, 24 in 0.01 mm. The type is reported from the North Sea and the Atlantic and Indian Oceans.[17]

AMPHORA PROTEUS Greg. var. BAIKALENSIS var. nov. Plate 12, figs. 16 and 25.

Frustule elliptic with obtuse ends. Length, 0.049 mm; breadth, 0.022. Valve lunate with slightly gibbous ventral side and subacute ends. Median line slightly biarcuate. Axial and central areas on the dorsal side indistinct. Dorsal part in the middle with compact striæ, with alveolate striæ at the ends about 9 in 0.01 mm. Ventral side with two distinct rows of striæ of 12 in 0.01 mm. Differs from the type in its striæ of the middle part of the dorsal side. *Amphora Proteus* Greg. is a marine diatom, common in the North Sea.[18]

CYMBELLA HUSTEDTII Krasske? Plate 12, fig. 11, Plate 17, fig. 30.

Cymbella Hustedtii Krasske, Fr. Hustedt, Bacillar. (1930) 363 fig. 674.

[17] Schmidt, Atlas Diatom. (1876) pl. 40, figs. 4–7, 11–13.
[18] Schmidt, op. cit. (1875) pl. 27, fig. 6.

Valve asymmetric, elliptic-lanceolate with broad ends. Length, 0.017 to 0.023 mm, breadth, 0.005 to 0.0065. Striæ radiate, dorsal 12, ventral 15, in 0.01 mm. Median line slightly oblique. Uncommon. The type is known from Europe.

CYMBELLA AMPHICEPHALA Naeg. var. UNIPUNCTATA Brun. Plate 3, fig. 4.

Cymbella amphicephala Naeg. var. *unipunctata* Brun, Diatomees lacustres, marines ou fossil. Le Diatomiste 2 (1895) pl. 14, fig. 33.

Valve slightly asymmetric, naviculiform with subrostrate ends, and a distinct isolated punctum near the central nodule. Length, 0.018 mm; breadth, 0.0068. Striæ 15 in 0.01 mm. Rare. Known from alpine lakes in Europe.

CYMBELLA NAVICULA sp. nov. Plate 8, figs. 32 and 33. Plate 12, fig. 13.

Valve slightly asymmetric, naviculiform, broad elliptic-rectangular with short subrostrate ends. Length, 0.035 to 0.051 mm, breadth, 0.017 to 0.02. Median line slightly oblique with small terminal fissures. Axial area linear, abruptly dilated around the central nodule to an orbicular excentric central area. Striæ radiate, punctate, 6 to 8 in 0.01 mm. Puncta 18 in 0.01 mm. A species akin to *C. lata* Grun.

CYMBELLA LACUSTRIS Ag. fo. BAIKALENSIS Skv. and Meyer. Plate 14, fig. 9.

Cymbella lacustris Ag. fo. *baicalensis* Skvortzow and Meyer, Contribution to the diatoms of Baika, Lake (1928) 34 pl. 3, fig. 153.

Valve lanceolate, slightly asymmetric with long, broad, obtuse ends. Length, 0.068 to 0.074 mm; breadth, 0.012 to 0.015. Median line with long, distinct, terminal fissures. Axial area narrow; central area orbicular. Striæ radiate, 12 to 13 in 0.01 mm, compact not lineate. The type is known from fresh and brackish waters.[19]

CYMBELLA SINUATA Greg. Plate 13, fig. 14.

Cymbella sinuata Greg., Fr. Hustedt, Bacillar. (1930) 361, fig. 668b.

Valve small, asymmetric, lineat with obtuse ends. Length, 0.013 mm; breadth, 0.0031. Striæ 12 in 0.01 mm. Smaller than the type. Rare.

CYMBELLA TURGIDA (Greg.). Plate 13, fig. 9. Plate 13, fig. 28.

Cymbella turgida (Greg.) Cleve, Fr. Hustedt, Bacillar. (1930) 358, fig. 660.

Valve lanate with slightly undulate dorsal and arcuate ventral side. Length, 0.032 to 0.068 mm; breadth, 0.0068 to 0.014. Median line straight, terminal fissures turned downward. Dor-

[19] Schmidt op. cit. (1881) pl. 71, figs. 1, 3.

sal striæ 9 to 10, ventral 7 to 9, in 0.01 mm. Common. Known in tropical regions.

CYMBELLA VENTRICOSA Kütz. Plate 12, fig. 11; Plate 13, figs. 11 and 18.

Cymbella ventricosa Kütz., Fr. Hustedt, Bacillar. (1930) 359, fig. 661.

Valve semielliptic. Length, 0.022 to 0.037 mm; breadth, 0.007. Striæ, dorsal and ventral, 11 to 12 in 0.01 mm. The specimen figured on Plate 12, fig. 27, was, in length, 0.025 mm; breadth, 0.0042. Striæ ventral 14 to 15, dorsal 15, in 0.01 mm. Common in Baikal.

CYMBELLA HETEROPLEURA Ehr. var. MINOR Cleve. Plate 13, figs. 12 and 15.

Cymbella sp., A. Schmidt, Atlas Diatom. (1875) pl. 9, figs. 51, 52.

Valve slightly asymmetric, lanceolate with rostrate ends. Length, 0.037 to 0.08 mm; breadth, 0.013 to 0.022. Striæ 7 in the middle, 9 at the ends, in 0.01 mm. Common. Known from Arctic and northern regions. Some forms (Plate 13, fig. 12) are smaller than the type.

CYMBELLA CUSPIDATA Kütz. Plate 3, fig. 19; Plate 13, figs. 1 and 27?

Cymbella cuspidata Kütz., Van Heurck, Synopsis (1880-1881) 61, pl. 2, fig. 3.

Valve broad asymmetric, linear-lanceolate with subrostrate ends. Length, 0.044 to 0.085 mm; breadth, 0.014 to 0.024. Median line slightly arcuate. Axial area linear, slightly dilated in the middle. Striæ radiate, 10 to 11 in 0.01 mm. Puncta 16 to 18 in 0.01 mm. Common.

CYMBELLA EHRENBERGII Kütz. Plate 13, figs. 21 and 24.

Cymbella Ehrenbergii Kütz., Van Heurck, Synopsis (1880) pl. 2 figs. 1, 2.

Cymbella Gutwinskii Skv. and Meyer var. *intermedia* Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 36, pl. 3, fig. 167.

Valve asymmetric, elliptic-lanceolate with subacuate ends. Length, 0.072 to 0.141 mm; breadth, 0.015 to 0.027. Central area suborbicular. Striæ 8 to 10 in the middle, 12 to 14 at the ends, in 0.01 mm. Common.

CYMBELLA MEISTERI Skv. and Meyer. Plate 13, figs. 6, 9, 20, and 26.

Cymbella Meisteri Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 36, pl. 3, fig. 165.

Valve asymmetric with slightly arcuate dorsal and ventral margins and long-attenuate, subacute ends. Length, 0.16 to 0.29 mm; breadth, 0.034 to 0.044. Median line arcuate with distinct

comma-shaped terminal fissures. Axial area narrow-linear; central area broad. Striæ radiate, linear, 6 to 8 in 0.01 mm. No rows of puncta below the central nodule. A distinct species known in Baikal. It has a slight resemblance to *C. Ehrenbergii* Kütz. var. *elongata* Meister, to which it was referred in my paper in 1928.[29]

CYMBELLA GUTWINSKII (Wisl.) Skv. and Meyer. Plate 13, figs. 7 and 12.

Cymbella Gutwinskii (Wisl.) Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 36, pl. 3, fig. 100.

Cymbella Ehrenbergii Kütz. var *Gutwinskii* Wisłouch, Beiträge zur Diatomeenflora von Asien, 2 Neuere Untersuchungen über die Diatomeen des Baikal-Sees (1924) 168, fig. 7.

Valve asymmetric, lanceolate with convex margins and long attenuate ends. Median line arcuate, axial area narrow, scarcely dilated in the middle. Length, 0.125 to 0.22 mm; breadth, 0.027 to 0.051. Striæ radiate, punctate, 8 to 11 in 0.01 mm. Common in Baikal. A distinct species akin to *C. Ehrenbergii* Kütz.

CYMBELLA PROSTRATA (Berkeley) Cleve. Plate 13, fig. 33.

Cymbella prostrata (Berkeley) Cleve, Fr. Hustedt, Kieselalg. (1930) 457, fig. 659.

Cymbella turgida var *robusta* Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 34, pl. 3 fig. 148.

Valve strongly asymmetric with obtuse ends. Length, 0.047 to 0.068 mm; breadth 0.017 to 0.025. Median line straight with large and distinct, comma-shaped, terminal fissures. Axial area narrow, scarcely dilated in the middle part of the valve. Striæ robust, linear, 5 to 7 in 0.01 mm. Very common. Known from fresh and slightly brackish waters of Europe.

CYMBELLA INELEGANS Cleve var BAIKALENSIS var. nov. Plate 13, fig. 16.

Cymbella turgida Greg var *punctata* Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 34, pl. 3, fig. 147.

Valve boat-shaped with arcuate dorsal and convex ventral margins. Length, 0.047 to 0.075 mm; breadth, 0.015 to 0.023. Median line arcuate with reflexed terminal fissures. Axial and central areas linear. Striæ robust, linear, radiate, 7 in 0.01 mm. Differs from the type in its convex ventral margins and by the absence of terminal pores. The type is known from fresh water, and from Fall River, Oregon, as fossil.[31]

[29] Meister, Kieselalgen der Schweiz (1912) 188, pl. 32, fig. 3.

[31] Cleve, Synopsis of the naviculoid Diatoms (1894) 1, 168, pl. 5, fig. 1.

CYMBELLA PARVA (W. Smith) Cleve. Plate 12, fig. 7.

Cymbella parva W. Smith, A. Schmidt, Atlas Diatom. (1875) pl. 10, figs. 14, 15.

Valve lunate, centrally from the ventral margin, slightly convex, with end turned downward. Length, 0.028 mm; breadth, 0.0068. Median line somewhat arcuate. Axial and central areas semilanceolate. Striæ radiate, lineate, 8 to 9 in 0.01 mm. Rare. Known from northern regions.

CYMBELLA CISTULA (Hemprich) Grun. Plate 13, figs. 29 and 31.

Cymbella cistula (Hemprich) Grun. Fr. Hustedt, Bacillar. (1930) 363, fig. 676a.

Valve boat-shaped, centrally convex. Length, 0.057 to 0.078 mm; breadth, 0.013 to 0.015. Striæ 9 in 0.01 mm. Puncta 22 in 0.01 mm. At the ventral side of the central nodule are 1 to 3 small puncta, ending the median striæ. Common.

CYMBELLA CISTULA (Hemprich) Grun. var. MACULATA (Kütz.) Van Heurck

Cymbella cistula (Hemprich) Grun. var. *maculata* (Kütz.) Van Heurck, Fr. Hustedt, Bacillar. (1930) 363, fig. 676b.

Valve boat-shaped with slightly gibbous ventral margin. Length, 0.056 mm; breadth, 0.015. Striæ, ventral 10, dorsal 9, in 0.01 mm. No rows of puncta below the central nodule. Infrequent.

CYMBELLA CISTULA (Hemprich) Grun. var. ARCTICA Lagerst. Plate 2, fig. 5.

Cymbella cistula Hempr. var. *arctica* Lagerstedt Sotvattens Diatomaceer fram Spitsbergen och Beeren Eiland (1873) pl. 10, fig. 12.

Valve boat-shaped with strongly arcuate dorsal and slightly concave ventral margin. Length, 0.09 mm; breadth, 0.017. Median line arcuate. Terminal fissures reflexed. Striæ, ventral and dorsal, 10 in 0.01 mm. Rare. Reported from Beeren Island, Spitzbergen, Lapland, and the mouth of Yenisei River, Siberia.

CYMBELLA STURERGII Cleve. Plate 13, fig. 4.

Cymbella Sturbergii Cleve, Cleve and Grunow, Beiträge zur Kenntniss der arctischen Diatomeen (1880) 13, pl. 1, fig. 10.

Valve arcuate with almost straight ventral margin, and subrostrate ends. Length, 0.062 mm; breadth, 0.018. Striæ, ventral and dorsal, 11 to 12 in 0.01 mm, crossed on the ventral side below the central nodule by a narrow depression. Known from the mouth of Yenisei River, from Koukounoor in western China, and common in Baikal.

CYMBELLA STUXBERGII Cleve var. INTERMEDIA Wis. Plate 11, figs. 2, 3.

Cymbella Stuxbergii Cleve var. *intermedia* Wisnicew, Beiträge zur Diatomeenflora von Asien, 2. Neuere Untersuchungen über die Diatomeen des Baikal-sees (1924) 170, fig. 1a–e.

Cymbella baicalensis Skv. and Meyer var. *Brunhardi* Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 36, pl. 3, fig. 164.

Valve boat-shaped with concave, centrally slightly gibbous, ventral margin and truncate or rounded ends. Length, 0.161 mm; breadth, 0.024. Median line strongly arcuate. Striæ 8 to 9 in 0.01 mm. Frenle crossed on the ventral side below the central nodule by a narrow depression. Common in Baikal Lake.

CYMBELLA STUXBERGII Cleve var. BAIKALENSIS var. nov. Plate 11, figs. 5 and 18.

Cymbella baikalensis Skvortzow and Meyer. Contribution to the diatoms of Baikal Lake (1928) 36, pl. 3, fig. 163.

Valve boat-shaped, strongly arcuate dorsal and almost straight ventral margins. Median line arcuate. Striæ 0.112 to 0.195 mm; breadth, 0.039 to 0.059. Striæ lineate, 6 to 8 in 0.01 mm. Lineolæ 8 in 0.01 mm. Striæ on the ventral side below the central nodule are crossed by a narrow depression. Common.

CYMBELLA AUSTRALICA A. Schmidt fa. ELONGATA Skv. and Meyer. Plate 11, figs. 4 and 17.

Cymbella australica A. Schmidt *fo. elongata* Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 32, pl. 3, fig. 143.

Valve boat-shaped, slightly gibbous in the ventral margin and long obtuse ends. Length, 0.17 to 0.204 mm; breadth, 0.029 to 0.032. Median line arcuate. Axial area narrow linear, central area abruptly dilated around the central nodule to an orbicular space. A distinct elongate stigma between the central pores. Striæ in the middle 6 to 7, at the ends 7 to 9, in 0.01 mm, slightly radiate and lineate. Common. The type is known from Australia, New Zealand, from Hanka Lake, eastern Siberia, and from Nippon."[2]

CYMBELLA CAPRICORNIS sp. nov. Plate 11, fig. 29.

Valve asymmetric with arcuate dorsal and convex ventral margins. Length, 0.074 mm; breadth, 0.017. Median line arcuate with distinct terminal fissures turned outward. Axial and central area semilanceolate, oblique. Striæ robust, radiate, punctate, not lineate, 7 in 0.01 mm. Puncta 12 in 0.01 mm. A form akin to *C. austriaca* Grun.

[2] Schmidt, Atlas Diatom. (1875) pl. 10, figs. 34, 35.

DIDYMOSPHENIA DENTATA Dorogostaisky. Plate 14 fig. 23.

Gomphonema dentatum Dorogostaisky, Materiaux pour servir a Palgologie du lac Baikal et de son bassin (1904) 256, pl. 6, figs. 1–3, C. I. Meyer and L. B. Reinhard, Contribution a la flore algologique du lac Baikal et de la Transbaikalie (1925) 242.

Didymosphenia dentata Dor. var *genuina* Skv. and Meyer and fo. *elongata* Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 31–32, pl. 3, figs. 139, 140.

Valve clavate, *Amphora*-shaped with gibbous middle part, abruptly attenuate, with subcapitate apex, and narrower, obtusely truncate base. Length, 0.076 to 0.178 mm; breadth, 0.048 to 0.054. Median line straight or slightly arcuate with short and robust terminal fissures. Axial area narrow, slightly enlarged in the middle, central area orbicular. Striæ robust, radiate, punctate, in the middle part of the valve alternately longer and shorter, 7 to 10 in 0.01 mm. Striæ at the base of the valve not reaching the ends. In the middle part of the valve the striæ form irregular longitudinal rows. The most peculiar character of this curious species is the spines along the margin from both sides of the valve. Spines are regular, about 3.5 to 5 in 0.01 mm. *Didymosphenia dentata* is only reported from Baikal Lake. Common.

DIDYMOSPHENIA DENTATA Dorogostaisky var. SUBCAPITATA Skv. and Meyer. Plate 14, fig. 15.

Didymosphenia dentata Dor. var *subcapitata* Skv. and Meyer and fo. *curta* Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 32, pl. 3, figs. 141, 142.

Differs from the type in its short not capitate apex. Length, 0.051 to 0.099 mm; breadth, 0.029 to 0.041. Striæ 6.5 in 0.01 mm. Common with the type.

[redacted]INATA (Lyngb.) W. Schmidt var SIBIRICA Grun. Plate 2, figs. 8, 10, and 12.

Gomphonema geminatum Lyngb. var. *sibirica* Grunow, Algen und Diatomeen aus dem Kaspischen Meere (1876) 11.

Gomphonema geminatum Lyngb var. *hybrida* Grunow, Diatomeen von Franz Josefs Land (1884) 97, pl. 1, fig. 11.

Didymosphenia sibirica (Grun.) M. Schmidt, A. Schmidt, Atlas der Diatom. (1899) pl. 214, figs. 1–3.

Didymosphenia geminata var. *sibirica* Grun. fo. *genuina* Skv. and Meyer, pl. 2, fig. 129; fo. *elongata* Skv. and Meyer, pl. 2, fig. 130; fo. *curta* Skv. and Meyer pl. 2, fig. 131; var. *Dorogostaisky* Skv. and Meyer, pl. 2, fig. 127, fo. *curta*, pl. 2 fig. 128 in Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 30–31.

Valve lanceolate-clavate, convex in the middle part, slightly attenuate to the upper and the lower parts. Ends broad-rounded. Length, 0.068 to 0.21 mm; breadth, 0.032 to 0.051. Median line straight or slightly curved, enlarged in the middle part, with distinct, large, comma-shaped, terminal fissures. Terminal area (nodule) at the upper part distinct, axial area narrow-linear, suddenly dilated around the central nodule to an orbicular space. At one side of the central nodule are 1 to 5 large isolated puncta or stigmata, disposed in a longitudinal row. Striæ radiate at the ends, in the middle alternately longer and shorter, punctate, 6 to 7 in 0.01 mm. A variable diatom very common in Baikal and known from Kossogol Lake, from Okhotsk, the mouth of Yenisei River, from Kamchatka, from Franz Josef Land, and from Neogene deposits in Saga Prefecture, Kiushiu Island, Nippon.

DIDYMOSPHENIA GEMINATA (Lyngb.) M. Schmidt var. SIBIRICA Grun. fo. SUBCAPITATA fo. nov. Plate 3, fig. 6.

Didymosphenia geminata var. *genuina* Skv. and Meyer fo. *baicalensis* Skvortzow and Meyer, pl. 2, fig. 120; fo. *curta* Skvortzow and Meyer, pl. 2, fig. 121. Contribution to the diatoms of Baikal Lake (1928) 30.

Differs from variety *sibirica* Grun. in having a subcapitate apex. Length, 0.085 to 0.127 mm; breadth, 0.04 to 0.042. Isolated puncta 1 to 3. Striæ 7 to 7.5 in 0.01 mm. Very common in Baikal.

DIDYMOSPHENIA GEMINATA (Lyngb.) M. Schmidt var. SIBIRICA Grun. fo. CURVATA fo. nov. Plate 14, figs. 8, and 28.

Didymosphenia geminata (Lyngb.) M. Schmidt var. *curvata* Skv. and Meyer, pl. 3, fig. 137; fo. *elongata* Skv. and Meyer, pl. 3, fig. 138; fo. *curta* Skv. and Meyer, pl. 2, figs. 132–134. Contribution to the diatoms of Baikal Lake (1928) 31.

Differs from the type in having slightly curvate valves. Length, 0.037 to 0.153 mm; breadth, 0.027 to 0.049. Median line slightly arcuate. Isolated puncta 1 to 2. Striæ 8 to 11 in 0.01 mm. Very common in Baikal Lake. Recently reported in Neogene deposits in Saga Prefecture, Kiushiu Island, Nippon.

DIDYMOSPHENIA GEMINATA (Lyngb.) M. Schmidt var. SIBIRICA Grun. fo. ANOMALA Skv. and Meyer.

Didymosphenia geminata (Lyngb.) M. Schmidt var. *sibirica* Grun. fo. *anomala* Skvortzow and Meyer. Contribution to the diatoms of Baikal Lake (1928) 31, pl. 2, fig. 135.

Differs from the type in having one stigma on one side of the central nodule and two others on the other side. Length,

0.21 mm; breadth, 0.044. Striæ 7 in 0.01 mm. A form not recorded from Olhon Gate

DIDYMOSPHENIA GEMINATA (Lyngb.) M. Schmidt var. STRICTA M. Schmidt. Plate 4, figs. 14 and 15; Plate 14, fig. 13; Plate 14, fig. 2.

Didymosphenia geminata (Lyngb.) M. Schmidt var. *stricta* M. Schmidt, A. SCHMIDT Atlas Diatom. (1890) pl. 214, figs. 11, 12

Didymosphenia geminata (Lyngb.) M. Schmidt var. *stricta* M. Schmidt fo. *baicalensis* SKV. and MEYER, pl. 2, fig. 130; var. *baicalensis* SKV. and MEYER, pl. 2, fig. 122; fo. *curta* SKV. and MEYER, pl. 2, fig. 124, fo. *elongata* SKV. and MEYER pl. 2, fig. 126; SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928), 31.

Valve clavate-lanceolate, convex in the middle with subcapitate apex, broader than the end. Length, 0.072 to 0.167 mm; breadth, 0.032 to 0.056. Stigmata 2 to 7 Striæ 8 in 0.01 mm. A variable diatom, common in Baikal and reported from Ladoga and Onega Lakes, northern Europe.

DIDYMOSPHENIA GEMINATA (Lyngb.) M. Schmidt var. STRICTA M. Schmidt fo. CURVATA fo. nov.

Didymosphenia geminata (Lyngb.) M. Schmidt var. *baicalensis* Skv. and Meyer fo. *curvata* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 30, pl. 2, fig. 123.

Differs from the type in its slightly curved valve with arcuate median line. Length, 0.072 mm; breadth, 0.034. Stigmata 2. Striæ 8 in 0.01 mm. Rare.

DIDYMOSPHENIA GEMINATA (Lyngb.) M. Schmidt var. STRICTA M. Schmidt fo. CAPITATA Skv. and Meyer.

Didymosphenia geminata (Lyngb.) M. Schmidt var. *stricta* M. Schmidt fo. *capita* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 30, pl. 2, fig. 125.

Differs from the type in its capitate apex and narrow middle part. Length, 0.222 mm; breadth, 0.048. Stigmata 5. Striæ 7 in 0.01 mm. Rare.

GOMPHONEMA QUADRIPUNCTATUM (Oestr.) Wisl. Plate 4, figs. 13, 16, and 14.

Gomphonema olivaceum Kütz. var. *quadripunctata* OESTRUP, Beiträge zur Kenntniss der Diatomeenflora des Kossogolbeckens in der nordwestlichen Mongolei. Hedwigia 48 (1909) pl. fig. 11.

Gomphonema quadripunctatum (Oestrup) WISLOUCH, Beiträge zur Diatomeenflora von Asien, 2 Neuere Untersuchungen über die Diatomeen des Baikal-Sees (1924) 166, 167, fig. 6

Gomphonema quadripunctatum (Oestrup) Wisl. var. *genuina* Skv. und MEYER, pl. 2, fig. 96, fo. *tumida* SKVORTZOW and MEYER, Contribution to the diatoms of Baikal Lake (1928) 27.

Valve clavate-lanceolate, concave in the middle, long-attennate to the ends. Length, 0.045 to 0.074 mm, breadth, 0.008 to

0.015. Median line straight, filiform with a distinct straight terminal fissure. Axial area narrow; central area broad, orbicular with four distinct puncta or stigmata on both sides of central nodules. Striæ radiate, lineate, 14 to 18 in 0.01 mm. Common in Baikal; known from Kossogol Lake of northern Mongolia and Onega Lake of northern Europe.

COCCONEMA QUADRIPUNCTATUM (Oestr.) Wisl. var. HASTATA Wisl. Plate 14, fig. 17.

Gomphonema quadripunctatum (Oestr.) Wisl. var. *hastata* Wislouch, Beiträge zur Diatomeenflora von Asien, 2. Neuere Untersuchungen über die Diatomeen des Baikal-sees (1924) 166–167, figs. 4–6.

Gomphonema quadripunctatum (Oestr.) Wisl. var. *genuina* Skv. and Meyer fo. *robusta* Skv. and Meyer, pl. 2, fig. 97; var. *hastata* Wisl. fo. *curta* Skvortzow and Meyer, pl. 2, fig. 101, Contribution to the diatoms of Baikal Lake (1928) 27.

Differs from the type in its rhombic-elliptic valves, with broad-rounded apex and subacute base. Length, 0.034 to 0.061 mm; breadth, 0.01 to 0.017. Striæ 14 to 15 in 0.01 mm. Apex with a distinct, transverse, round, marginal, siliceous rib. In some valves this rib is absent. Very common in Baikal Lake. Reported by me from Imengol River, near Hailar, western Manchuria, and from Kizaki Lake, Nippon.

COCCONEMA INNATA sp. nov. Plate 14, fig. 2.

Gomphonema elegans Grun. var. *quadripunctata* Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 29, pl. 2, figs. 115, 116.

Valve clavate, lanceolate, tapering from the middle towards the obtuse ends. Length, 0.052 mm; breadth, 0.013. Median line straight with distinct terminal fissures. Axial area narrow, central area orbicular. Costæ radiate, robust, compact, not lineate or punctate, 12 in 0.01 mm. Central area with 4 stigmata. Differs from *C. quadripunctatum* (Oestr.) Wisl. in its robust, not lineate, striæ from *Gomphonema elegans* Grun. in the absence of longitudinal lines and punctate costæ. A distinct, robust species. Uncommon in Baikal.

COCCONEMA IRRATA sp. nov. var. RUSSIANA var. nov. Plate 14, fig. 3.

Differs from the type in the long-lanceolate valve with attenuate rounded apex and subcapitate end. Length, 0.107 mm; breadth, 0.02. Costæ in the middle 10, at the ends 12, in 0.01 mm, not lineate. Central area with 10 stigmata. Rare.

COCCONEMA OLIVACEUM (Lyngb.) Kütz. Plate 14, fig. 21.

Gomphonema olivaceum (Lyngb.) Kütz., A. Schmidt, Atlas Diatom. (1902) p. 233, figs. 9–16.

Valve lanceolate, scarcely clavate, tapering from the middle towards the obtuse ends. Length, 0.042 mm; breadth, 0.01. Median line filiform with distinct terminal fissures. Axial area narrow, central area broad. Costæ distinctly compact and not lineate, radiate throughout and of unequal length in the middle part. 11 in 0.01 mm. No stigma below the central nodule. Rare.

GOMPHONEMA INTRICATUM Kütz. var. FENDLA Grun. Plate 14, fig. 6.

Gomphonema intricatum Kütz. var. *punctata* Grun., Van Heurck, Synopsis (1880) pl. 24, figs. 35, 36.

Valve sublinear with attenuate subacute ends. Length, 0.035 mm; breadth, 0.012. Axial area narrow, central area transverse and broad. Striæ subparallel, obscurely punctate, 10 to 11 in 0.01 mm. Isolated puncta distinct. Uncommon.

GOMPHONEMA INTRICATUM Kütz. var. MINOR var. nov. Plate 14, figs. 1 and 14.

Smaller than variety *punctata* Grun. Length, 0.012 to 0.018 mm; breadth, 0.0025 to 0.0031. Striæ 12 in 0.01 mm. Isolated puncta distinct. Striæ in the middle part not so distinctly interrupted. Infrequent.

GOMPHONEMA VENTRICOSUM Greg. Plate 14, figs. 5, 11, 22, and 24.

Gomphonema ventricosum Greg., Van Heurck, Synopsis (1880) pl. 25, fig. 13.

Valve clavate with broad middle part and attenuate ends. Apex subacute and the ends subcapitate. Length, 0.02 to 0.056 mm; breadth, 0.0035 to 0.013. Median line straight with distinct, long, terminal fissures and a comma-shaped transverse fissure near the central pores. Axial area narrow; central area orbicular. Striæ radiate, punctate, 9 to 16 in 0.01 mm. A variable diatom, very common in Baikal Lake. Known from Scotland, Norway, Sweden, Finland, Yenisei River, Kamchatka, and Onega Lake of northern Europe. According to Wislouch and Kolbe *G. ventricosum* can be regarded as a relict of glacial times.

GOMPHONEMA FIRMA sp. nov. Plate 18, fig. 12.

Gomphonema herculeanum Ehrenb., Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 26, pl. 2, fig. 106.

Valve lanceolate, clavate, gradually tapering from the middle to the obtuse apex and base. The latter is broader than the apex. Length, 0.125 mm; breadth, 0.02. Median line with distinct, long, terminal fissures and comma-shaped fissures near the central pores. Axial area linear-lanceolate, covered with indis-

tinct irregular puncta; central area broad with a stigma. Striæ robust, coarsely punctate, subparallel or slightly radiate, 9 in the middle, 10 to 11 at the ends, in 0.01 mm. A species closely related to *G. ventricosum* Greg. Uncommon.

GOMPHONEMA DELICATULA sp. nov. Plate 14, fig. 4.

Gomphonema crienae Grun. var. *baicalensis* Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 29, pl. 2, fig. 114.

Valve lanceolate and very slightly clavate, broad in the middle part, tapering to the subacute ends. Length, 0.051 to 0.07 mm; breadth, 0.012 to 0.013. Median line filiform with distinct terminal fissures. Axial area narrow, central area slightly broader. Striæ radiate, fine-punctate, longer and shorter in the middle part, 14 to 15 in 0.01 mm, with a distinct stigma between the central pores. A new species not closely connected with *G. ventricosum* Ehr. Rare.

GOMPHONEMA DELICATULA sp. nov. var. BIPUNCTATA var. nov. Plate 14, fig. 13.

Valve lanceolate with subcapitate apex and long-attenuate ends. Length, 0.068 mm; breadth, 0.014. Striæ fine-punctate, 13 in 0.01 mm. Central area with 2 stigmata. Differs from the type in the capitate apex and the presence of 2 stigmata. This form is connected with *G. ventricosum* Ehr. and var. *ornata* Grun.

GOMPHONEMA LANCEOLATUM Ehr. Plate 14, figs. 12 and 23.

Gomphonema lanceolatum Ehr. A. Schmidt, Atlas Diatom. (1902) pl. 235, figs. 26, 27.

Valve clavate, gradually tapering from the middle to the obtuse apex and base. Length, 0.073 to 0.083 mm; breadth, 0.01 to 0.012. Axial area linear, somewhat enlarged in the middle part; central area suborbicular with one isolated stigma. Striæ coarsely punctate, 10 to 12 in 0.01 mm. Very common in Baika.

GOMPHONEMA LANCEOLATUM Ehr. var. CAPITATA var. nov. Plate 14, fig. 16.

Differs from the type in its broad capitate apex. Length 0.09 mm; breadth, 0.014. Striæ coarsely punctate, 8 in 0.01 mm. Rare.

EPITHEMIA TURGIDA (Ehr.) Kütz. var. GRANULATA (Ehr.) Grun. Plate 13, fig. 11.

Epithemia turgida (Ehr.) Kütz. var. *granulata* (Ehr.) Grun., Fr. Hustedt, Bacillar. (1930) 387, fig. 734.

Valve with arcuate dorsal and constricted ventral margins. Length, 0.069 mm; breadth, 0.012. Costæ 4 in 0.01 mm. Striæ 1 to 3 between costæ. Common.

EPITHEMIA ZEBRA (Ehr.) Kütz. Plate 10, fig. 9.

Epithemia zebra (Ehr.) Kütz., Fr. Hustedt, Bacillar. (1930) 384–385, fig. 729.

Valve linear-lanceolate with arcuate dorsal and slightly convex ventral margins. Length, 0.049 mm; breadth, 0.0085. Costæ 3, alveoli 12 to 14, in 0.01 mm. Infrequent.

EPITHEMIA INTERMEDIA Fricke. Plate 11, fig. 5.

Epithemia intermedia Fricke, Fr. Hustedt, Bacillar. (1930) 387, fig. 732.

Valve with arcuate dorsal and almost ventral margins. Ends obtuse. Length 0.032 mm; breadth, 0.012. Costæ 4, striæ 12, in 0.01 mm. Rare. Known from European lakes.

RHOPALODIA GIBBA (Ehr.) O. Müll. Plate 11, fig. 7.

Rhopalodia gibba (Ehr.) O. Müll., Fr. Hustedt, Bacillar. (1930) 390, fig. 740.

Valve linear, arcuate on the dorsal, straight on the ventral side, reflexed at the extremities. Length, 0.078 mm; breadth, 0.02. Costæ 7 to 8, striæ about 15, in 0.01 mm. Very rare.

RHOPALODIA GIBBA (Ehr.) O. Müll. var. MONGOLICA Oestrup. Plate 11, fig. 14.

Rhopalodia gibba (Ehr.) O. Müll. var. *mongolica* Oestrup, Beiträge zur Kenntniss der Diatomeenflora des Kossogolbeckens in der nordwestlichen Mongolei (1909) 80, pl. fig. 12.

Differs from var. *ventricosa* in its more lunate valves. Length, 0.042 mm; breadth, 0.02. Costæ 7, striæ 15, in 0.01 mm. Rare. Known from Kossogol Lake.

Genus NITZSCHIA Hassall

NITZSCHIA ANGUSTATA (W. Smith) Grun. Plate 11, figs. 13 and 19.

Nitzschia angustata (W. Smith.) Grun., Fr. Hustedt, Bacillar. (1930) 402, fig. 767.

Valve linear-lanceolate with parallel margins and abruptly attenuate ends. Length, 0.025 to 0.027 mm; breadth, 0.005 to 0.0052. Striæ 16 in 0.01 mm. Uncommon.

Grunowiæ (Pabil.) Grunow

NITZSCHIA DENTICULATA Grun. var. BAIKALENSIS var. nov. Plate 1, fig. 10.

Differs from the type in its subcapitate ends. Length, 0.12 mm; breadth, 0.006. Keel puncta 8, striæ 30, in 0.01 mm. Rare.

Dissipatæ Grunow

NITZSCHIA DISSIPATA (Kütz.) Grun. Plate 10, fig. 11.

Nitzschia dissipata (Kütz.) Grun., Fr. Hustedt, Bacillar. (1930) 412, fig. 789.

Valve linear-lanceolate with attenuate ends. Length, 0.064 mm, breadth, 0.0068. Keel puncta 7 in 0.01 mm. Striæ indistinct. Rare.

NITZSCHIA ACUTA Hantzsch. Plate 1, fig. 21.

Nitzschia acuta Hantz., Fr. Hustedt, Bacillar. (1930) 412, fig. 700.

Valve narrow-lanceolate with long-attenuate, subcapitate ends. Length, 0.109 mm, breadth, 0.005. Keel puncta 6 to 7 in 0.01 mm. Striæ indistinct. Infrequent.

LANCEOLATÆ Grunow

NITZSCHIA CAPITELLATA Hust. Plate 11, fig. 4.

Nitzschia capitellata Hustedt, Bacillar. (1930) 414, fig. 702.

Valve lanceolate with abruptly attenuate and capitate ends. Length, 0.047 mm; breadth, 0.005. Keel puncta 15, striæ about 35, in 0.01 mm. Differs from the type in its coarser striæ. Infrequent.

NITZSCHIA GRACILIS Hantzsch. Plate 3, fig. 19.

Nitzschia gracilis Hantzsch., A. Schmidt, Atlas Diatom. (1924) pl. 349, figs. 34–37.

Valve linear-lanceolate with attenuate ends. Length, 0.069 to 0.076 mm; breadth, 0.0034. Keel puncta 15, striæ about 35, in 0.01 mm. Infrequent.

NITZSCHIA BAIKALENSIS sp. nov. Plate 3, fig. 8.

Valve narrow lanceolate, gradually tapering to obtuse ends. Length, 0.025 to 0.032 mm; breadth, 0.0029. Keel puncta 12 to 16 in 0.01 mm. Striæ indistinct. A species related to *N. fonticola* Grun. Infrequent.

NITZSCHIA FONTICOLA Grun. Plate 1, figs. 17 and 18.

Valve lanceolate, convex in the middle part and attenuate at the ends. Length, 0.01 to 0.012 mm; breadth, 0.0025 to 0.0031. Keel puncta 15 to 18 in 0.01 mm. Striæ indistinct. Differs from the type in its indistinct striæ. Uncommon.

SIGMOIDEÆ (Grunow) Hustedt

NITZSCHIA SIGMOIDEA (Ehr.) W. Smith.

Nitzschia sigmoidea (Ehr.) W. Smith, Fr. Hustedt, Bacillar. (1930) 419, fig. 810.

Frustule very large, sigmoid with broad ends. Uncommon.

CYMATOPLEURA SOLEA (Breb.) W. Smith. Plate 15, figs. 4 and 5, Plate 16, fig. 2; Plate 17, fig. 12.

Cymatopleura solea (Breb.) W. Smith, Fr. Hustedt, Bacillar. (1930) 425, fig. 820a, A. Schmidt, Atlas Diatom. (1911) pl. 276, figs. 2, 3.

Valve linear-lanceolate, constricted in the middle. Length, 0.096 to 0.127 mm, breadth, 0.022. Costæ 7 to 8 in 0.01 mm. Infrequent.

CYMATOPLEURA SOLEA (Breb.) W. Smith var. APICULATA (W. Smith) Grun. Plate 17, fig. 3.

Cymatopleura solea (Breb.) W. Smith var. *apiculata* (W. Smith) Grun., A. Schmidt, Atlas Diatom. (1911) pl. 276, fig. 1, 1a.

Differs from the type in its apiculate ends. Rare.

CYMATOPLEURA ELLIPTICA (Breb. W. Smith var. CONSTRICTA Grun. Plate 16, fig. 10.

Cymatopleura elliptica (Breb.) W. Smith var. *constricta* Grun., Fr. Hustedt, Bacillar. (1930) 428, fig. 826.

Valve broad, elliptic-linear, slightly constricted in the middle. Long diameter, 0.102 mm; short diameter, 0.047. Costæ 3, striæ 18, in 0.01 mm. Uncommon. Known from alpine lakes.

CYMATOPLEURA ANGULATA Grev. Plate 16, fig. 6.

Cymatopleura angulata Grev., Fr. Hustedt, Bacillar. (1930) 426, fig. 824.

Valve elliptic-linear with apiculate ends. Long diameter, 0.093 mm; short diameter, 0.035. Costæ 3.5, striæ 18, in 0.01 mm. Rare.

SURIRELLA LINEARIS W. Smith. Plate 17, fig. 11.

Surirella linearis W. Smith, Fr. Hustedt, Bacillar. (1930) 434, figs. 837, 838.

Valve linear-lanceolate with subacute ends. Long diameter, 0.081 mm; short diameter, 0.015. Costæ 2.5 in 0.01 mm. Rare.

SURIRELLA LINEARIS W. Smith var. HELVETICA (Brun) Meister? Plate 16, fig. 12.

Surirella linearis W. Smith var. *helvetica* (Brun) Meister?, Fr. Hustedt, Bacillar. (1930) 434, fig. 840.

Valve elliptic-lanceolate with distinct marginal ala and costæ of 1.5 to 2 in 0.01 mm, reaching the median area. Intercostal striæ 18 in 0.01 mm. The median area forms a longitudinal line of closely set transverse lines. Long diameter, 0.115 mm; short diameter, 0.037. Our specimens recall *S. turgida* var. *lanceolata* Wislouch and Kolbe from Onega Lake, northern Russia.[*]

SURIRELLA BISPICATA Breb. var. NITIDUS (Ehr.) Hust. fo. PUNCTATA Meister. Plate 15, fig. 7; Plate 17, fig. 4.

Surirella bispicata Breb. var. *punctata* Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 41, pl. 3, fig. 186.

* Wislouch and Kolbe, New diatoms from Russia (1916) 264, pl. 7, fig. 1.

Valve elliptic with acute end. Marginal alæ robust. Costæ 2 in 0.01 mm, reaching the central area. The surface of the valve is covered with distinct scattered beads. Long diameter, 0.085 to 0.102 mm; short diameter, 0.039 to 0.044. Common.

SURIRELLA GRANULATA Ostrup. Plate 16, fig. 12.

Surirella granulata Ostrup, Beiträge zur Kenntnis der Diatomeen-flora des Kossogolbeckens in der nordwestlichen Mongolei (1909) 91, fig. 17.

Valve linear-lanceolate or elliptic-linear. Costæ marginal, not reaching the center, 2.5 in 0.01 mm. All the surface of the valve is covered with beads. Long diameter, 0.064 mm; short diameter, 0.014. Differs from the type in having no longitudinal line in the center of the valve. The type is known from Kossogol Lake.

SURIRELLA TERCIDA W. Smith to. BAIKALENSIS fo. nov. Plate 16, fig. 10.

Valve broad, elliptic with acute ends. Marginal alæ robust. Costæ dilated at the margin and attenuate towards the ends, 2.5 in 0.01 mm. Striæ between costæ very fine. Long diameter, 0.061 mm, short diameter, 0.034. Around the central area are two longitudinal rows of beads. Differs from the type in its more elliptic valve and beads distributed in longitudinal lines. Rare.

SURIRELLA MARGARITIFERA Hust. Plate 16, fig. 6; Plate 17, fig. 2.

Surirella margaritifera Hustedt, A. Schmidt, Atlas Diatom. (1922) pl. 354, fig. 8.

Valve elliptic-lanceolate with subacute ends. Costæ distinct, 2 in 0.01 mm, reaching an indistinct central area. The valve is covered with spines and longitudinal and radiate striæ 18 in 0.01 mm. Striæ consist of irregular puncta. The type is known from Tanganyika Lake, Africa.

SURIRELLA GRACILIS (W. Smith) Grun. Plate 17, fig. 4.

Surirella gracilis (W. Smith) Grun., Fr. Hustedt Bacillar. (1930) 435, fig. 243.

Valve linear-lanceolate with parallel margins and subacute ends. Costæ 5, striæ 20, in 0.01 mm. Long diameter, 0.127 mm; short diameter, 0.027. Rare.

SURIRELLA BIBENSIS Kütz. var. MINOR var. nov. Plate 16, fig. 4.

Valve constricted in the middle, with subacute ends. Costæ marginal, 2.5 in 0.01 mm. Long diameter, 0.042 mm; short diameter, 0.01. No longitudinal line in the middle part of the

valve. Differs from the type in the absence of a longitudinal line in the middle part of the valve. Infrequent.

SURIRELLA NYASSÆ O. Müll. var. BAIKALENSIS var. nov. Plate 15, fig. 1; Plate 16, fig. 6.

Valve long, linear-lanceolate, constricted in the middle part with broad apiculate ends. Costæ very distinct, 4 to 4.5 in 0.01 mm, reaching the median line. Intercostal striæ 15 to 16 in 0.01 mm. Long diameter, 0.055 to 0.088 mm; short diameter in the middle of the valve, 0.011 to 0.033, and at the enlarged ends, 0.017. The type specimens are 0.343 to 0.433 mm in length and 0.047 to 0.080 mm in breadth, and are recorded from plankton of Nyassa Lake, Africa.[24]

SURIRELLA ACUMINATA Hust. var. BAIKALENSIS var. nov. Plate 3, fig. 9; Plate 17 fig. 4.

Valve linear-lanceolate, strongly constricted in the middle, and with long apiculate ends. Outer rim narrow, finely crossbarred. Marginal alæ robust. Costæ dilated at the margin and attenuate towards the pseudoraphe, 1.5 to 2 in 0.01 mm. Intercostal striæ 12 to 15 in 0.01 mm. Differs from *S. acuminata* Hustedt, reported from Tanganyika Lake, Africa, in its more robust costæ and in having no longitudinal line in the middle part of the central area.[25]

SURIRELLA PERKINSII sp. nov. Plate 13, fig. 7.

Valve elliptic-lanceolate with acute ends and somewhat curved lower part. Marginal alæ robust. Costæ distinct, 2 in 0.01 mm, reaching linear-lanceolate central area, covered with puncta, beads, and little spines. Intercostal lineate striæ are distinct. A species akin to *S. curvifacies* J. Brun, of sea waters.[26]

SURIRELLA OSPHORA sp. nov. Plate 23, fig. 1.

Surirella ovata Breb. var. *baikalensis* Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928, 42, pl. 3, fig. 177.

Valve oval with one end much broader than the other. Costæ robust, radiate, about 1 in 0.01 mm, running two-thirds of the way to the center. Marginal alæ robust. Intercostal striæ fine, 22 to 24 in 0.01 mm. Long diameter, 0.124 mm; short diameter, 0.068 to 0.079. Little spines irregularly along the costæ ends

[24] Müller, Bacillarieaceen aus dem Nyassalande und einiger benachb. Gebieten aus Beiträge zur Flora von Africa (1904) xxv, 23, pl. 2, fig. 3

[25] Schmidt, Atlas Diatom. (1922) pl. 350, figs. 5, 6.

[26] Schmidt, op. cit. (1925) pl. 362, fig. 1.

are distinct. Central area lanceolate and distinctly linear. A distinct species, common in Baikal.

SURIRELLA UNDOSA sp. nov. Plate 16, fig. 3.

Valve broad oval with one end much broader than the other. End broad-rounded, spirally curved. Outer rim very distinct. Marginal alæ robust and broad curved costæ, 1 to 1.5 in 0.01 mm., radiating to the central area. Between the costæ are fine, punctate, long lines, and a series of spines. Lines 15 in 0.01 mm. A distinct species, akin to *S. spiralis* Kutz.

SURIRELLA TRIDENTATA sp. nov. Plate 12, fig. 2.

Valve broad-elliptic with broad rounded ends, and with one large spine in the upper part of the central area. Outer rim distinct. Marginal rib of the costæ robust. Costæ strong, 1 in 0.01 mm, running to the center. Between the costæ are beads or spines. A distinct species seen several times.

SURIRELLA CONIFERA sp. nov. Plate 16, fig. 1.

Valve ovate with slightly acute ends. Outer rim narrow. Marginal alæ not robust. Costæ marginal, 2 in 0.01 mm. All the surface of the valve is covered with radiating, fine, irregular, interrupted striæ. Long diameter, 0.147 mm; short diameter, 0.08. A species not allied to any other. Infrequent.

SURIRELLA CONIFERA sp. nov. var. PUNCTATA var. nov. Plate 16, fig. 4.

Differs from the type in the valve being covered with non-radiate puncta. Costæ 2 in 0.01 mm. Long diameter, 0.111 mm; short diameter, 0.076. Rare.

SURIRELLA LACUS BAIKALI sp. nov. Plate 15, fig. 5.

Valve broad-elliptic with acute ends. Valve surface separated into two areas; the outer with distinct costæ, and the inner area with a diameter of a little over one-half that of the valve. Outer rim distinctly crossbarred with costæ. Marginal alæ indistinct. Costæ fine, about 15 in 0.01 mm, running radiately halfway to the center. Between costæ lines of longitudinal striæ, and longitudinal lines of irregular dark beadings or blotches. The inner or central area separated by a longitudinal line, covered with dark beading. A distinct, variable species, common in Baikal.

SURIRELLA LACUS BAIKALI sp. nov. var. MARGINATA var. nov. Plate 12, fig. 3, Plate 15, fig. 3.

Surirella fastuosa O. Müll. var. *baicalensis* Skvortzow and Meyer, Contribution to the diatoms of Baikal Lake (1928) 41, pl. 3, fig. 175.

Valve elliptical with distinct, dark marginal costæ of 2 to 2.5 in 0.01 mm. Valve surface covered with fine radiating lines without beads. Long diameter, 0.237 mm; short diameter, 0.127. Very common in Baikal.

SURIRELLA LACUS BAIKALI sp. nov. var. PUNCTATA var. nov. Plate 16, fig. 11.

Differs from variety *typica* in having no dark marginal costal rib. All the surface is covered with fine puncta. Long diameter, 0.238 mm, short diameter, 0.119. Costæ 2 in 0.01 mm. Infrequent.

SURIRELLA LACUS BAIKALI sp. nov. var. PARADOXA var. nov. Plate 15, fig. 4.

Valve elliptic-lanceolate with attenuate and subacute ends. Border consists of an outer narrow row and large subcircular alæ. Costæ distinct, 1 to 1.5 in 0.01 mm, dilated at the margin, attenuate towards the central area. Between costæ are distinct lines of striæ about 12 to 13 in 0.01 mm, and intermediate longitudinal lines of irregular beadings or blotches, covering the whole central area of elliptic shape. Long diameter, 0.12 mm; short diameter, 0.064.

SURIRELLA PAUCIDENS sp. nov. Plate 15, fig. 5.

Valve elliptic with subacute ends. Outer rim narrow and distinct. Marginal alæ fine and regular, costæ radiate, reaching the center. Intercostal striæ fine, 18 to 22 in 0.01 mm. Long diameter, 0.185 to 0.238 mm; short diameter, 0.083 to 0.086. A species not akin to others. Common.

SURIRELLA PAUCIDENS sp. nov. var. PUNCTATA var. nov. Plate 17, figs. 8 and 11.

Differs from the type in the presence of a long line in the middle part of the valve and distinct punctate striæ. Long diameter, 0.187 mm; short diameter, 0.08. Differs from *S. biseriata* Breb. and *S. lanceolata* Hust. in its more numerous costæ. The last diatom is reported from Tanganyika Lake.

CAMPYLODISCUS LACUS BAIKALI sp. nov. Plate 17, fig. 9.

Valve circular or slightly bent with distinct band or rim. Costæ strong, running about to the center, 40 in number, 1 to 1½ in 0.01 mm. Between the costæ are fine, closely set parallel lines, 21 to 22 in 0.01 mm. Central area linear, indistinct. No puncta or beads. Diameter, 0.085 to 0.093 mm. Differs from *C. noricus* Ehr. in its linear and not quadrate or orbicular central area. Common.

CAMPYLODISCUS LACUS BAIKALI sp. nov. var. MISPIRELLA var. nov. Plate 17, fig. 5.

Valve subcircular with distinct rib and radiate costæ reaching the elongate median area. Costæ 1 to 1.5 in 0.01 mm. Striæ

very fine with irregular small beads. Diameter, 0.136 to 0.153 mm. Differs from the type in the presence of small beads.

CAMPYLODISCUS LACUS BAIKALI sp. nov. var. ANNULATA var. nov. Plate 17, fig. 10.

Valve circular with a narrow, distinct, finely crossbarred outer rim and robust costæ 2 in 0.01 mm, running radially three-fourths of the way to the center. Striæ 20 in 0.01 mm. Linear elliptic central portion of the valve covered with parallel lines of striæ and small puncta. Diameter, 0.119 to 0.125 mm. Differs from the type in its linear-elliptic central portion. Common.

CAMPYLODISCUS RUTILUS sp. nov. Plate 16, fig. 7; Plate 17, fig. 6.

Valve very dark in color, circular or semicircular with distinct marginal rib and robust costæ about 1 in 0.01 mm, reaching the median line. Between the costæ are lines and irregular dots of red-brown color. Diameter, 0.136 to 0.17 mm. One of the largest and most robust *Campylodiscus* species in Baikal. Differs from all other Baikal species of the genus in its robust costæ and distinct structure.

CAMPYLODISCUS FRAGILIS sp. nov. Plate 18, figs. 2, 4, 5, 7, and 9.

Valve circular, sometimes strongly curved on one or both sides with narrow marginal rib. Fine radiate costæ reach the central area. Costæ 3 in 0.01 mm, covered with beads, forming regular longitudinal rows, and at the same time between costæ are double lines of irregular puncta, reaching the central part of the valve. Diameter, 0.06 to 0.07 mm. A distinct and variable species. Common.

CAMPYLODISCUS FRAGILIS sp. nov. var. PUNCTATA var. nov. Plate 18, fig. 1.

Valve curved beaded and punctate. Puncta irregular and not in rows. Costæ 2, beads 5 to 6, in 0.01 mm. Diameter, 0.085 to 0.09 mm.

CAMPYLODISCUS FRAGILIS sp. nov. var. BIGENS var. nov. Plate 18, figs. 11 and 12.

Valve circular, strongly bent with a narrow outer rim and robust costæ 2.5 to 3 in 0.01 mm, running radially to the center. Between the costæ are robust, irregular beads, disposed in longitudinal rows. Diameter 0.1 to 0.105 mm. A very distinct and robust form. Very common.

BIBLIOGRAPHY

Berg, L. S.

Die Fauna des Baikalsees und ihre Herkunft. Archiv für Hydrobiologie Supp. Bd 4 (1926).

Nouvelles données sur la question de l'origine de la faune de lac Baikal. Compt Rend. de l'Acad. Sci de l'URSS 1923,.

Beyrich, H.

Melosira und ihre Planktonbegleiter. Pflanzenforschung, Heft 3, Jena (1925).

Brun, J.

Diatomees lacustres, marines ou fossiles. Le Diatomiste 2 (1895).

Cleve, P. T

The diatoms of Finland Acta Societatis pro fauna et flora Fennica 8 (1891) 3 pls.

Synopsis of the Naviculoid Diatoms. Parts 1 and 2. Stockholm (1894–1905) 9 pls

Cleve P. T., and A. Gronow.

Beiträge zur Kenntniss der Arctischen Diatomeen. Stockholm (1880) 7 pls.

Dorogostaisky, V.

Materiaux pour servir a l'algologie du lac Baikal et de son bassin. Bull. Soc. Nat. d. Moscou (1901).

Gronow, A.

Algen und Diatomaceen aus dem Kaspischen Meere. Dresden (1878).

Beiträge zur Kenntniss der Fossilen Diatomeen Oesterreich-Ungarns. Beiträge zur Palaeontologie Oesterreich-Ungarns 2 (1882) 4.

Diatomeen von Franz Josefs-Land. Wien (1884).

Gutwinski, R.

O pionowem rozsiedleniu glonow jeziora Baicalskiego. Kosmos 15 (1890) 498–505, Lwow.

Algarum e lacu Baikal et a paeninsula Camtschatka a cl. viris. prof. Dr S. Dybowsky anno 1877 reportarum enumeratio et Diatomacearum lacus Bajcal cum undem tatricorum, italicorum et franco-gallicorum lacuum comparatio. Nuova Notarisia Ser. 2 (1891) 1–27, 300–305, 357–366, 407–417.

Henckel, A. H.

Einige Materialien zum Phytoplanktone des Baikalsees. Bull. Biol Inst. of Perm University 3 (1925) Hf. 3.

Heribaud, J

Diatomees d'Auvergne (1893).

Hustedt Fr.

Die Kieselalgen aus Dr. L. Rabenhorsts Kryptogamen-Flora von Deutschland, Oesterreich und der Schweiz. Lief 1–4 Leipzig (1927–1930)

Bacillariophyta aus die Süsswasser-Flora Mitteleuropas. Jena (1930).

JASNITSKI, V.
Material for study of plankton from Lake Baikal. Travaux de la Soc. de Natur. d'Irkoutsk 1, Liw 1 (1923).
Einige Resultate der hydrobiologischen Erforschungen auf dem Baikalsee im Sommer 1925. Comp. Rend. de l'Acad. Sci. de l'URSS (1928).

JOHANSEN, H.
Der Baikalsee. Mitt. d. Geogr. Gesellschaft in München 60 (1925).

LINDHOLM, W.
Kritische Studien zur Molluskenfauna des Baikalsees. Trav. Comm. Baikal (1927).

MEISTER, FR.
Die Kieselalgen der Schweiz. Bern (1912).

MEYER, K. I.
Quelques recherches scientifiques sur la flore des algues du lac Baikal. Journ. Moscow Branch of Russian Bot. Soc. 1 (1922).
On phytoplankton of Baikal. Russisch Hydrobiol. Zeitschrift, 6 (1927).
On algae of northern part of Baikal Lake. Archiv für Protistenkunde 6 (1927).
Ueber die Auxosporenbildung bei Gomphonema geminatum. Archiv für Protistenkunde 68 (1929) pls. 15–16.

MEYER, K. I., and L. B. REINHARDT.
Contribution à la flore algologique du lac Baikal et de la Transbaikalie. Bull. Moscow Nat. Hist. Soc. (1925).

MÜLLER, O.
Bacillariaceen aus dem Nyassalande und einigen benachbarten Gebieten. Beiträge zur Flora von Africa von A. Engler. Leipzig (1904).

OESTRUP, E.
Beiträge zur Kenntniss der Diatomeenflora des Kosogolbeckens in der nordwestlichen Mongolei. Hedwigia 48 (1909) 74–100, pls. 1, 2.

PANTOCSEK, J.
Beiträge zur Kenntniss der Fossilen Bacillarien Ungarns, 3 Teile. Berlin (1903).

SCHMIDT, A.
Atlas der Diatomaceenkunde (1875–1931) pls. 1–876.

SHAMSTSCHEWSKY, A. P.
Ueber die Biologie von Melosira baikalensis (K. Meyer) Wisl. Russisch. Hydrobiol. Zeitschrift 8 (1929).

SKVORTZOW, B. W.
Alpine diatoms from Fukien Province, South China. Philip. Journ. Sci. 41 (1930) 3 pls.
Diatoms from Biwa Lake, Honshu Island, Nippon. Philip. Journ. Sci. 41 (1930) 8 pls.
Diatoms from Chengtu, Szechwan, western China. 4 pls.

SKVORTZOW, B. W., and K. MEYER.
A contribution to the diatoms of Baikal Lake. Proc. Sungaree River Biol. Sta. 1 (1928) Harbin.

VAN HEURCK, H
Synopsis des Diatomees Belgiques. Anvers (1880–1881)

WERESCHTSCHAGIN, G. I.
Nouvelles etudes du lac Baikal. Comp. rend. de l'Acad. Sci. de l'URSS (1927)
Vorläufige Betrachtungen über den Ursprung der Fauna and Flora des Baikalsees. Comp. rend. de l'Acad. Sci. de l'URSS (1928).
Baikal Lake in Siberia. Encyclopedia 4 (1928).

WERTIENAJA P. J.
Ueber eine reakte Algenflora in den Seeablagerungen Mittelrusslands. Archiv für Hydrobiol. 20: 124–133.

WISLOUCH, S. M.
Beiträge zur Diatomeenflora von Asien, 2. Neuere Untersuchungen über die Diatomeen des Baikal-sees. Bericht d. Deut. Bot. Gesellsch. 42 Heft 4 (1924).

WISLOUCH, S. M. and R. KOLBE.
New diatoms from Russia. Journ. of Microbiol. 3 (1916) Petrograd.
Beiträge zur Diatomeenflora des Onega-sees (1927) 1 pl. Leningrad.

ILLUSTRATIONS

[Drawings by the author, made with Zeiss Apochromat 2 mm and compens ocular 4]

PLATE 1

FIG. 1. *Melosira baikalensis* (K. Meyer) Wisl., frustules with mature cell wall.
2. *Melosira baikalensis* (K. Meyer) Wisl., frustules with mature cell wall.
3. *Melosira baikalensis* (K. Meyer) Wisl. fo. *compacta* fo. nov.
4. *Melosira baikalensis* (K. Meyer) Wisl., polymorphism in frustules, the lower frustule is matured, the upper is formed.
5. *Melosira baikalensis* (K. Meyer) Wisl., sporangial frustule.
6. *Melosira baikalensis* (K. Meyer) Wisl., sporangial frustule.
7. *Melosira baikalensis* (K. Meyer) Wisl. fo. *compacta* fo. nov.
8. *Melosira baikalensis* (K. Meyer) Wisl. fo. *oblonga-punctata* Skv and Meyer.
9. *Melosira baikalensis* (K. Meyer) Wisl. fo. *compacta* fo. nov.
10. *Melosira baikalensis* (K. Meyer) Wisl., auxospore.
11. *Melosira baikalensis* (K. Meyer) Wisl., frustule 0.03 mm in breadth.
12. *Melosira baikalensis* (K. Meyer) Wisl., sporangial frustule.
13. *Fragilaria spinosa* sp. nov.
14. *Melosira arenaria* Moore var. *baikalensis* var. nov. fo. *ornata* fo.
15. *Melosira arenaria* Moore var. *baikalensis* var. nov.
16. *Melosira arenaria* Moore.
17. *Nitzschia frustrata* Grun.
18. *Nitzschia frustrata* Grun.
19. *Nitzschia gracilis* Hantz.
20. *Nitzschia denticulata* Grun. var. *baikalensis* var. nov.
21. *Nitzschia acuta* Hantz.
22. *Melosira arenaria* Moore var. *baikalensis* var. nov. fo. *punctata* fo. nov.
23. *Melosira arenaria* Moore var. *baikalensis* var. nov.
24. *Melosira Binderana* Kütz.
25. *Melosira Binderana* Kütz.
26. *Melosira arenaria* Moore.
27. *Fragilaria spinosa* sp. nov.
28. *Melosira arenaria* Moore var. *baikalensis* var. nov.

PLATE 2

FIG. 1. *Stephanodiscus Hantzschii* Grun.
2. *Stephanodiscus Hantzschii* Grun.
3. *Stephanodiscus astraea* (Ehr.) Grun. var. *minutula* (Kütz.) Grun.
4. *Cyclotella baikalensis* Skv. and Meyer fo. *ornata* fo. nov.

FIG. 5. *Stephanodiscus Hantzschii* Grun.
6. *Cyclotella baikalensis* Skv. and Meyer fo. *typica* fo. nov.
7. *Cyclotella baikalensis* Skv. and Meyer fo. *typica* fo. nov.
8. *Cyclotella baikalensis* Skv. and Meyer fo. *ornata* fo. nov.
9. *Cyclotella baikalensis* Skv. and Meyer fo. *ornata* fo. nov.
10. *Cyclotella baikalensis* Skv. and Meyer fo. *minuta* fo. nov.
11. *Cyclotella baikalensis* Skv. and Meyer fo. *ornata* fo. nov.
12. *Cyclotella baikalensis* Skv. and Meyer fo. *ornata* fo. nov.
13. *Cyclotella baikalensis* Skv. and Meyer fo. *ornata* fo. nov.
14. *Cyclotella baikalensis* Skv. and Meyer fo. *minuta* fo. nov.
15. *Cyclotella baikalensis* Skv. and Meyer fo. *minuta* fo. nov
16. *Cyclotella baikalensis* Skv. and Meyer fo. *ornata* fo. nov.
17 *Cosmodiscus radiatus* Ehr.
18. *Coscinodiscus radiatus* Ehr.
19. *Cymbella cuspidata* Kütz.
20. *Cyclotella baikalensis* Skv. and Meyer fo. *typica* fo. nov.

PLATE 3

FIG. 1. *Cyclotella baikalensis* Skv and Meyer fo. *stellata* fo. nov.
2. *Cyclotella baikalensis* Skv and Meyer fo. *typica* fo nov.
3. *Didymosphenia geminata* (Lyngb.) M. Schmidt var. *sibirica* Grun.
4. *Cyclotella baikalensis* Skv. and Meyer fo. *stellata* fo. nov.
5. *Cyclotella baikalensis* Skv. and Meyer fo. *stellata* fo. nov.
6. *Didymosphenia geminata* (Lyngb.) M. Schmidt var *sibirica* Grun. fo. *subcapitata* fo. nov.
7. *Surirella acuminata* Hust. var *baikalensis* var. nov.
8. *Nitzschia baikalensis* sp. nov
9. *Cymbella cistula* (Hemp.) Grun. var. *arctica* Lagerst
10. *Didymosphenia geminata* (Lyngb.) M. Schmidt var. *sibirica* Grun
11. *Cyclotella baikalensis* Skv and Meyer, from the frustule view.
12. *Didymosphenia geminata* (Lyngb.) M Schmidt var. *sibirica* Grun

PLATE 4

FIG. 1. *Synedra Vaucheriae* Kütz. var *capitellata* Grun.
2. *Eunotia Lacus Baikali* sp. nov.
3. *Eunotia praerupta* Ehr.
4. *Eunotia Clevei* Grun. var. *baikalensis* var. nov.
5. *Eunotia Clevei* Grun. var. *baikalensis* var. nov.
6. *Eunotia Clevei* Grun. var. *baikalensis* var. nov.
7. *Tabellaria fenestrata* (Lyngb.) Kütz.
8. *Eunotia Clevei* Grun.
9. *Eunotia Clevei* Grun. var. *hispida* var. nov.
10. *Eunotia praerupta* Ehr. var. *inflata* Grun.
11. *Eunotia praerupta* Ehr. var. *inflata* Grun.
12. *Tetracyclus lacustris* Ralfs.
13. *Fragilaria spinosa* sp nov
14. *Didymosphenia geminata* (Lyngb.) M. Schmidt var. *stricta* M. Schmidt.
15. *Didymosphenia geminata* (Lyngb.) M. Schmidt var. *stricta* M. Schmidt.

FIG. 16. *Opephora Martyi* Herib.
17. *Eunotia arcuomodon* Hust.
18. *Eunotia Clevei* Grun. var. *biepida* var nov.
19. *Fragilaria spinosa* sp. nov.

PLATE 5

FIG. 1. *Achnanthes Meyeri* sp. nov
2. *Achnanthes Meyeri* sp. nov.
3. *Achnanthes profunda* sp. nov.
4. *Achnanthes exilor* Cleve.
5. *Cocconeis placentula* (Ehr.) var. *baikalensis* var nov.?
6. *Synedra rumpens* Kütz
7. *Cocconeis placentula* (Ehr.) var *baikalensis* var nov.
8. *Cocconeis placentula* (Ehr) var *baikalensis* var. nov.
9. *Achnanthes Oestrupii* (A. Cleve) Hust.
10. *Achnanthes Oestrupi.* (A. Cleve) Hust.
11. *Achnanthes striata* Skv. and Meyer.
12. *Achnanthes striata* Skv. and Meyer.
13. *Achnanthes lanceolata* Breb.
14. *Achnanthes lanceolata* Breb. var. *elliptica* Cleve.
15. *Achnanthes Peragalli* Brun and Herib.
16. *Achnanthes Lacus Baikali* sp. nov.
17. *Navicula tenuirensis* Cleve var. *abscnsis* Cleve.
18. *Achnanthes lanceolata* Breb. var. *rostrata* Hust.
19. *Achnanthes lanceolata* Breb.
20. *Achnanthes Oestrupii* (A. Cleve) Hust.
21. *Achnanthes Clevei* Grun. var. *rostrata* Hust.
22. *Achnanthes Meyeri* sp. nov.
23. *Achnanthes Meyeri* sp. nov
24. *Eucocconeis baikalensis* sp. nov.
25. *Achnanthes lanceolata* Breb.
26. *Achnanthes profunda* sp. nov
27. *Achnanthes Lacus Baikali* sp. nov.
28. *Achnanthes lanceolata* Breb.
29. *Achnanthes exigua* Grun. var. *baicalensis* var. nov
30. *Achnanthes exigua* Grun. var. *baikalensis* var. nov.
31. *Achnanthes profunda* sp. nov.
32. *Achnanthes lastata* Skv. and Meyer.
33. *Achnanthes hostata* Skv and Meyer
34. *Achnanthes baikalensis* Skv and Meyer
35. *Achnanthes baikalensis* Skv. and Meyer
36. *Achnanthes Clevei* Grun. var. *rostrata* Hust.
37. *Achnanthes profunda* sp. nov.
38. *Cocconeis diminuta* Pant.
39. *Cocconeis diminuta* Pant.
40. *Achnanthes Oestrupii* (A. Cleve) Hust. var. *minuta* var. nov
41. *Eucocconeis baikalensis* sp. nov.
42. *Achnanthes exigua* Grun. var *baikalensis* var. nov.
43. *Achnanthes exigua* Grun. var. *baikalensis* var. nov.
44. *Eucocconeis baikalensis* sp. nov.

FIG. 45. *Achnanthes striata* Skv. and Meyer
46. *Achnanthes striata* Skv. and Meyer.
47. *Achnanthes striata* Skv. and Meyer
48. *Opephora Martyi* Herib. var *baikalensis* var. nov.
49. *Fragilaria pinnata* Ehr.
50. *Eucocconeis baikalensis* sp. nov.
51. *Cocconeis placentula* (Ehr.) var. *linearis* (Ehr.) Cleve.
52. *Cocconeis placentula* (Ehr.) var. *Rouxii* Brun and Herib.
53. *Cocconeis placentula* (Ehr.) var. *Rouxii* Brun and Herib.
54. *Fragilaria spinosa* sp. nov.
55. *Fragilaria pinnata* Ehr. var. *baikalensis* var. nov.
56. *Opephora Martyi* Herib.
57. *Eucocconeis baikalensis* sp. nov.
58. *Eucocconeis baikalensis* sp. nov.
59. *Fragilaria spinosa* sp. nov.
60. *Gyrosigma acuminatum* (Kütz.) Rabh. var. *baikalensis* var. nov.
61. *Synedra rumpens* Kütz.
62. *Gyrosigma Spencerii* (W. Smith) Cleve var. *nodifera* Grun.
63. *Eucocconeis oregonica* Wisl. and Kolbe.
64. *Gyrosigma baikalensis* sp. nov.
65. *Gyrosigma baikalensis* sp. nov.
66. *Eucocconeis oregonica* Wisl. and Kolbe.

PLATE 6

FIG. 1. *Diploneis puella* (Schum.) Cleve.
2. *Diploneis baikalensis* Skv. and Meyer.
3. *Diploneis domblittensis* (Grun.) Cleve.
4. *Diploneis elliptica* Cleve var. *ladogensis* Cleve.
5. *Diploneis marginestriata* Hust. var. *nipponica* Skv.
6. *Diploneis lata* sp. nov. var *punctata* var. nov.
7. *Diploneis domblittensis* (Grun.) Cleve var. *baikalensis* var. nov.
8. *Diploneis Boldtiana* Cleve var. *baikalensis* var. nov.
9. *Diploneis turgida* sp. nov.
10. *Diploneis turgida* sp. nov. var. *bipunctata* var. nov.
11. *Diploneis Meyeri* sp. nov.
12. *Diploneis lata* sp. nov. var. *minuta* var. nov.
13. *Diploneis ovalis* (Hilse) Cleve.
14. *Diploneis subovalis* Cleve var. *baikalensis* var. nov.
15. *Diploneis domblittensis* (Grun.) Cleve var. *baikalensis* var. nov.
16. *Diploneis ovalis* (Hilse) Cleve var. *nipponica* Skv.
17. *Diploneis lata* sp. nov.
18. *Diploneis baikalensis* Skv. and Meyer.
19. *Diploneis puella* (Schum.) Cleve var. *baikalensis* var. nov.

PLATE 7

FIG. 1. *Stauroneis baikalensis* sp. nov.
2. *Navicula subhamulata* Grun. var. *gibbosa* var. nov.
3. *Navicula cuspidata* Kütz.
4. *Navicula costulata* Grun. var. *baikalensis* var. nov.
5. *Navicula Werestschagini* Skv. and Meyer.

FIG. 6 *Navicula confervacea* Kütz. var. *baikalensis* var nov.
7 *Neidium dubium* (Ehr.) Cleve var. *baikalensis* var nov.
8. *Navicula peregrina* (Ehr.) Kütz.
9. *Navicula Lacus Baikali* Skv. and Meyer var *lanceolata* var. nov.
10. *Caloneis silicula* (Ehr.) Cleve.
11. *Navicula hasta* Pant.
12. *Caloneis latiuscula* (Kütz.) Cleve.
13. *Navicula anglica* Ralfs.
14 *Caloneis relicta* sp. nov.
15. *Navicula delicatula* sp. nov.
16. *Navicula anglica* Ralfs?
17. *Stauroneis anceps* Ehr. var *baikalensis* var. nov.
18. *Caloneis Schumanniana* (Grun.) Cleve var. *biconstricta* Grun. fo. *baicalensis* fo. nov.
19. *Navicula hasta* Pant.
20. *Navicula lanceolata* (Agardh.) Kütz
21. *Navicula lacustris* Greg. var. *baikalensis* var. nov.
22 *Navicula costuloides* sp. nov.
23 *Navicula Lacus Baikali* Skv. and Meyer.
24. *Navicula subalpina* Kütz. var. *oregonica* Cleve
25. *Navicula cryptocephala* Kütz. var *exilis* (Kütz.) Grun.
26. *Navicula subocculata* Hust. var. *baikalensis* var. nov.
27. *Navicula Meyeri* sp. nov.
28. *Navicula arguens* sp. nov.
29. *Caloneis delicatula* sp. nov.
30. *Navicula mesiaculus* Schum.
31. *Neidium Lacus Baikali* sp. nov.
32. *Navicula amphiceros* Ralfs
33 *Neidium dilatatum* (Ehr.) Cleve fo. *curta* fo. nov.
34. *Navicula placentula* (Ehr.) Grun. fo. *jenisseyensis* (Grun.) Meister.
35. *Navicula dalmatica* sp. nov.
36. *Navicula gastrum* Ehr.

PLATE 8

FIG. 1. *Navicula granulifera* sp. nov
2. *Navicula exigua* (Greg.) O. Müll.
3. *Navicula turcula* (Ehr.) Grun.
4. *Navicula paradoxa* sp. nov.
5. *Navicula lacustris* Greg.
6. *Navicula rhynchocephala* Kütz.
7. *Navicula dalmatica* sp. nov
8. *Cymbella amphicephala* Naeg. var *unipunctata* Brun
9. *Navicula peregrina* (Ehr.) Kütz. var *kefvingensis* (Ehr.) Cleve?
10. *Navicula unipunctata* sp. nov
11 *Navicula tornaensis* Cleve var. *aborensis* Cleve.
12. *Navicula delicatula* sp. nov.
13. *Navicula Lacus Baikali* Skv. and Meyer var. *lanceolata* var nov.
14. *Caloneis silicula* (Ehr.) Cleve var. *major* var. nov
15. *Neidium dilatatum* (Ehr.) Cleve.

FIG. 16. *Caloneis Schumanniana* (Grun.) Cleve var. *biconstricta* Grun. fo. *undulata* fo. nov.
17. *Navicula annulata* Grun. var. *baikalensis* var. nov.
18. *Caloneis Zachariasi* Reich. var. *elongata* var. nov.
19. *Navicula peregrina* (Ehr.) Kütz.
20. *Caloneis venefa* sp. nov.
21. *Navicula pupula* Kütz. var. *baikalensis* var. nov.
22. *Navicula pupula* Kütz. var. *capitata* Hust.
23. *Neidium dubium* (Ehr.) Cleve fo. *constricta* Hust.
24. *Navicula cingens* sp. nov.
25. *Navicula magna* sp. nov.
26. *Caloneis ignorata* sp. nov.
27. *Navicula magna* sp. nov.
28. *Navicula lanceolata* (Agardh) Kütz. var. *tenuirostris* var. nov.
29. *Caloneis Schumanniana* (Grun.) Cleve.
30. *Navicula placentula* (Ehr.) Grun. fo. *jenisejensis* (Grun.) Meister.
31. *Navicula rostellata* Kütz.
32. *Cymbella navicula* sp. nov.
33. *Caloneis Schumanniana* (Grun.) Cleve var. *biconstricta* Grun. fo. *baikalensis* fo. nov.
34. *Caloneis amphisbæna* sp. nov.
35. *Cymbella navicula* sp. nov.
36. *Navicula acuta* sp. nov.
37. *Navicula bacillum* Ehr.

PLATE 9

FIG. 1. *Navicula Wislouchii* Skv. and Meyer.
2. *Navicula placentula* (Ehr.) Grun.
3. *Navicula Lacus Baikali* Skv. and Meyer.
4. *Navicula amphibola* Cleve var. *ovata* var. nov.
5. *Navicula fluens* Hust. var. *subrostrata* var. nov.
6. *Navicula vulpina* Kütz.
7. *Navicula cryptocephala* Kütz.
8. *Navicula Lacus Baikali* Skv. and Meyer var. *simplex* Skv. and Meyer.
9. *Navicula cryptocephala* Kütz. var. *veneta* (Kütz.) Grun.
10. *Caloneis Schumanniana* (Grun.) Cleve var. *biconstricta* Grun. fo. *baikalensis* fo. nov.
11. *Navicula costulata* Grun.
12. *Navicula rhynchocephala* Kütz. var. *tenuis* Skv.
13. *Navicula subcincta* Hust. var. *unilateralis* var. nov.
14. *Navicula gracilis* Ehr.
15. *Navicula cryptocephala* Kütz.
16. *Navicula bacillum* Ehr.
17. *Navicula atomus* (Naeg.) Grun.
18. *Navicula formosensis* Cleve var. *aboensis* Cleve.
19. *Navicula delicatula* sp. nov.

FIG. 20. *Navicula pseudogracilis* sp. nov.
21. *Navicula pseudogracilis* sp. nov.
22. *Caloneis Schumanniana* (Grun.) Cleve var. *bicostaticta* Grun.
23. *Navicula rostellata* Kütz.
24. *Caloneis latiuscula* (Kütz.) Cleve.
25. *Navicula cruciculu* (W. Smith) Donk. var. *obtusata* Grun
26. *Pinnularia leptosoma* Grun.
27. *Caloneis Zachariasi* Reich. var. *constricta* var. nov.
28. *Navicula magna* sp. nov var. *lanceolata* var. nov
29. *Navicula Meyeri* sp. nov.
30. *Navicula placentula* (Ehr.) Cleve fo. *rostrata* A. Mayer.
31. *Navicula subplacentula* Hust. var. *baikalensis* var. nov.
32. *Caloneis Zachariasi* Reich.?
33. *Caloneis Zachariasi* Reich.?
34. *Navicula fluens* Hust. var. *baikalensis* var. nov.
35. *Caloneis latiuscula* (Kütz.) Cleve var. *rostrata* var. nov
36. *Navicula magna* sp. nov
37. *Navicula subhamulata* Grun var. *parallela* Skv.
38. *Navicula lanceolata* (Ag.) Kutz var. *cymbula* (Donk.) Cleve.
39. *Navicula silicea* sp. nov.
40. *Navicula scutelloides* W. Smith var *baikalensis* var. nov
41. *Neidium dubium* (Ehr.) Cleve.
42. *Navicula Meyeri* sp. nov.
43. *Navicula tornecensis* Cleve var. *obscura* Cleve.
44. *Navicula placentula* (Ehr.) Cleve fo. *rostrata* A. Mayer.
45. *Caloneis Zachariasi* Reach. var. *constricta* var. nov.
46. *Navicula placentula* (Ehr.) Cleve fo. *rostrata* A. Mayer.
47. *Navicula anglica* Ralfs var. *subsalsa* Grun.
48. *Navicula rhynchocephala* Kütz. var. *tenera* Skv.
49. *Stauroneis phoenicenteron* Ehr.

PLATE 10

FIG. 1. *Navicula americana* Ehr.
2. *Navicula Wereatschagini* Skv. and Meyer.
3. *Neidium lanceolata* sp. nov.
4. *Neidium iridis* (Ehr.) Cleve var *baikalensis* var. nov
5. *Neidium antiqua* sp. nov.
6. *Navicula lacustris* Greg.
7. *Navicula Lacus Baikal* Skv. and Meyer var. *simplex* Skv. and Meyer
8. *Frustulia rhomboides* (Ehr.) de Toni var. *amphipleuroides* Grun.
9. *Epithemia zebra* (Ehr.) Kütz.
10. *Diploneis Meyeri* sp. nov
11. *Nitzschia dissipata* (Kütz.) Grun.
12. *Gomphonema forma* sp. nov
13. *Didymosphenia geminata* (Lyngb.) M. Schmidt var. *stricta* M. Schmidt.
14. *Navicula magna* sp. nov. var. *curta* var. nov.
15. *Epithemia turgida* (Ehr.) Kütz. var. *granulata* (Ehr.) Grun.

PLATE 11

FIG. 1. *Pinnularia obnavinia* sp. nov.
2. *Pinnularia Lacus Baikali* sp. nov.
3. *Pinnularia Lacus Baikali* sp. nov
4. *Nitzschia capitellata* Hust.
5. *Pinnularia major* (Kütz.) Cleve.
6. *Pinnularia Lacus Baikali* sp. nov. var. *lanceris* var nov.
7. *Rhopalodia gibba* (Ehr.) O. Müll.
8. *Epithemia intermedia* Fricke.
9. *Pinnularia molaris* Grun.
10. *Pinnularia pectinalis* sp. nov.
11. *Pinnularia pectinalis* sp. nov var *rostrata* var nov
12. *Pinnularia pectinalis* sp. nov var. *rostrata* var. nov.
13. *Nitzschia angustata* (W. Smith) Grun.
14. *Rhopalodia gibba* (Ehr.) O. Müll. var *mongolica* Oestr
15. *Pinnularia viridissima* sp. nov.
16. *Pinnularia major* (Kütz.) Cleve fo. *minor* fo. nov.
17. *Pinnularia gibba* Ehr. var. *baikalensis* var. nov.
18. *Pinnularia Lacus Baikali* sp. nov var. *gibbosa* var. nov.
19. *Nitzschia angustata* (W. Smith) Grun.
20. *Pinnularia Lacus Baikali* sp. nov. var *lanceolata* var nov.
21. *Pinnularia Lacus Baikali* sp. nov.
22. *Pinnularia cruesa* sp. nov.

PLATE 12

FIG. 1. *Amphora costulata* sp. nov.
2. *Amphora ovalis* Kütz. var *pediculus* Kutz.
3. *Cymbella parva* (W. Smith) Cleve
4. *Amphora delphinea* (Bail.) A Smith.
5. *Amphora Normani* Rabh.
6. *Amphora mongolica* Oestr. var. *cornuta* var. nov.
7. *Amphora mongolica* Oestr. var. *cornuta* var nov. fo. *interrupta* fo. nov.
8. *Amphora mongolica* Oestr. var. *baikalensis* Skv and Meyer.
9. *Cymbella turgida* (Greg.) Cleve
10. *Amphora ovalis* Kütz. fo. *gracilis* (Ehr.) Cleve.
11. *Cymbella ventricosa* Kütz.
12. *Amphora sibirica* Skv. and Meyer.
13. *Amphora mongolica* Oestr. var. *gracilis* var. nov
14. *Amphora sibirica* Skv. and Meyer.
15. *Cymbella Hustedtii* Krasske?
16. *Amphora Proteus* Greg. var. *baikalensis* var nov.
17. *Amphora ovalis* Kütz. var. *constricta* var. nov
18. *Amphora rotunda* sp. nov.
19. *Amphora sibirica* Skv. and Meyer var *gracilis* var. nov.
20. *Amphora obtusa* Greg var *baikalensis* var nov.
21. *Amphora mongolica* Oestr
22. *Amphora perpusilla* Grun
23. *Amphora sibirica* Skv. and Meyer.
24. *Amphora ovalis* Kütz.

Fig. 25. *Amphora Proteus* Greg. var. *baikalensis* var. nov.
26. *Amphora sibirica* Skv. and Meyer.
27. *Amphora sibirica* Skv. and Meyer.
Amphora obtusa Greg. var. *baikalensis* var. nov.

PLATE 13

Fig. 1. *Cymbella cuspidata* Kütz.
2. *Cymbella Stuxbergii* Cleve var. *intermedia* Wisl.
3. *Cymbella Stuxbergii* Cleve var. *intermedia* Wisl.
4. *Cymbella australica* A. Schmidt fo. elongata Skv. and Meyer.
5. *Cymbella Stuxbergii* Cleve var. *baikalensis* var. nov.
6. *Cymbella Meisteri* Skv. and Meyer.
7. *Cymbella Gutwinskii* (Wisl.) Skv. and Meyer.
8. *Cymbella Meisteri* Skv. and Meyer.
9. *Cymbella Stuxbergii* Cleve.
10. *Cymbella finlandica* Cleve var. *baikalensis* var. nov.
11. *Cymbella ventricosa* Kütz.
12. *Cymbella heteropleura* Ehr. var. *minor* Cleve.
13. *Cymbella navicula* sp. nov.
14. *Cymbella sinuata* Greg.
15. *Cymbella heteropleura* Ehr. var. *minor* Cleve.
16. *Cymbella Hustedtii* Krasske?
17. *Cymbella australica* A. Schmidt fo. *elongata* Skv. and Meyer.
18. *Cymbella ventricosa* Kütz.
19. *Cymbella Stuxbergii* Cleve var. *baikalensis* var. nov.
20. *Cymbella Meisteri* Skv. and Meyer.
21. *Cymbella Ehrenbergii* Kütz.
22. *Cymbella Gutwinskii* (Wisl.) Skv. and Meyer.
23. *Cymbella prostrata* (Berk.) Cleve.
24. *Cymbella cistula* (Hem.) Grun.
25. *Cymbella Ehrenbergii* Kütz.
26. *Cymbella Meisteri* Skv. and Meyer.
27. *Cymbella cuspidata* Kütz.?
28. *Cymbella turgida* (Greg.) Cleve.
29. *Cymbella capricornis* sp. nov.
30. *Fragilaria Lacus Baikali* sp. nov.
31. *Cymbella cistula* (Hem.) Grun.

PLATE 14

Fig. 1. *Gomphonema innata* sp. nov. var. *elegans* var. nov.
2. *Gomphonema innata* sp. nov.
3. *Gomphonema intricatum* Kütz. var. *minor* var. nov.
4. *Gomphonema delicatula* sp. nov.
5. *Gomphonema ventricosum* Greg.
6. *Gomphonema intricatum* Kütz. var. *pumila* Grun.
7. *Didymosphenia geminata* (Lyngb.) M. Schmidt var. *stricta* M. Schmidt.
8. *Didymosphenia geminata* (Lyngb.) M. Schmidt var. *sibirica* Grun. fo. *curvata* fo. nov.
9. *Cymbella lacustris* Ag. fo. *baikalensis* Skv. and Meyer.

FIG. 10. *Rhoicosphenia curvata* (Kütz.) Grun.
11. *Gomphonema ventricosum* Greg
12. *Gomphonema lanceolatum* Ehr.
13. *Gomphonema quadripunctatum* (Oestr.) Wisl.
14. *Gomphonema intricatum* Kütz var. *minor* var. nov.
15. *Didymosphenia dentata* Dorog var. *subcapitata* Skv. and Meyer
16. *Gomphonema quadripunctatum* (Oestr.) Wis.
17. *Gomphonema quadripunctatum* (Oestr.) Wisl. var. *hastata* Wisl.?
18. *Gomphonema quadripunctatum* (Oestr.) Wisl.
19. *Gomphonema delicatula* sp. nov var *bipunctata* var. nov.
20. *Didymosphenia geminata* (Lyngb.) M. Schmidt var. *sibirica* Grun. fo. *curvata* fo. nov.
21. *Gomphonema olivaceum* (Lyngb.) Kütz.
22. *Gomphonema ventricosum* Greg.
23. *Didymosphenia dentata* Dorog
24. *Gomphonema ventricosum* Greg.
25. *Gomphonema lanceolatum* Ehr.
26. *Gomphonema lanceolatum* Ehr. var. *capitata* var. nov.

PLATE 15

FIG. 1. *Surirella elliptica* sp. nov
2. *Surirella Lacus Baikali* sp. nov.
3. *Surirella Nyassæ* O. Müll var *baikalensis* var. nov
4. *Cymatopleura solea* (Breb.) W. Smith.
5. *Cymatopleura solea* (Breb.) W. Smith
6. *Surirella peracuminata* sp. nov.
7. *Surirella biseriata* Breb. var. *bifrons* (Ehr.) Hust. fo. *punctata* Meister.
8. *Surirella Lacus Baikali* sp. nov. var. *marginata* var. nov.
9. *Surirella Lacus Baikali* sp. nov. var. *paradoxa* var. nov.

PLATE 16

FIG. 1. *Surirella conifera* sp. nov.
2. *Cymatopleura solea* (Breb.) W. Smith.
3. *Surirella minutissima* sp. nov.
4. *Surirella conifera* sp. nov. var. *punctata* var. nov.
5. *Surirella margaritifera* Hust.
6. *Surirella Nyassæ* O. Müll. var. *baikalensis* var. nov.
7. *Campylodiscus ratulus* sp. nov.
8. *Surirella didyma* Kütz. var. *minor* var. nov.
9. *Surirella Lacus Baikali* sp. nov. var *marginata* var. nov.
10. *Surirella turgida* W. Smith fo. *baikalensis* fo. nov.
11. *Surirella Lacus Baikali* sp. nov. var. *punctata* var. nov.
12. *Surirella granulata* Oestr.
13. *Surirella lucaris* W. Smith var. *helvetica* (Brun) Meister?

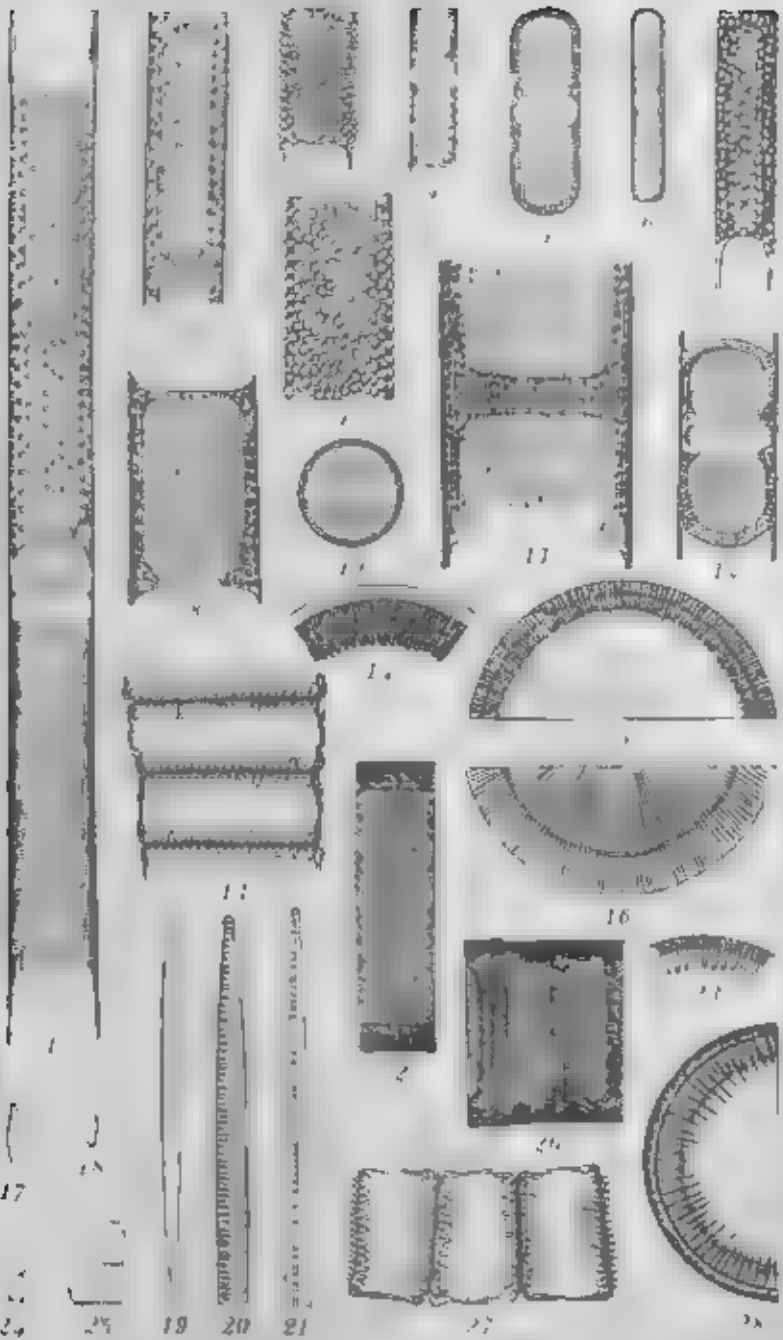
PLATE 17

FIG. 1. *Surirella biseriata* Breb. var. *bifrons* (Ehr.) Hust. fo. *punctata* Meister.
2. *Surirella margaritifera* Hust.
3. *Surirella unidentata* sp. nov

FIG. 4 *Surirella acuminata* Hust. var. *baikalensis* var. nov.
5. *Surirella gracilis* (W. Smith) Grun.
6. *Campylodiscus vitilus* sp. nov.
7. *Surirella prehensilis* sp. nov.
8. *Surirella pannicula* sp. nov. var. *punctata* var. nov.
9. *Campylodiscus Lacus Baikali* sp. nov.
10. *Campylodiscus Lacus Baikali* sp. nov. var. *annulata* var. nov.
11. *Surirella linearis* W. Smith.
12. *Cymatopleura solea* (Breb.) W. Smith var. *apiculata* (W. Smith) Grun.
13. *Cymatopleura solea* (Breb.) W. Smith.
14. *Surirella paucidens* sp. nov. var. *punctata* var. nov.

PLATE 18

FIG. 1. *Campylodiscus fragilis* sp. nov. var. *punctata* var. nov.
2. *Campylodiscus fragilis* sp. nov.
3. *Nedium Lacus Baikali* sp. nov., middle part of the valve.
4. *Campylodiscus fragilis* sp. nov.
5. *Campylodiscus fragilis* sp. nov.
6. *Cymatopleura angulata* Grev.
7. *Campylodiscus fragilis* sp. nov.
8. *Campylodiscus Lacus Baikali* sp. nov. var. *hispidula* var. nov.
9. *Campylodiscus fragilis* sp. nov.
10. *Cymatopleura elliptica* (Breb.) W. Smith var. *constricta* Grun.
11. *Campylodiscus fragilis* sp. nov. var. *rigens* var. nov.
12. *Campylodiscus fragilis* sp. nov. var. *rigens* var. nov.



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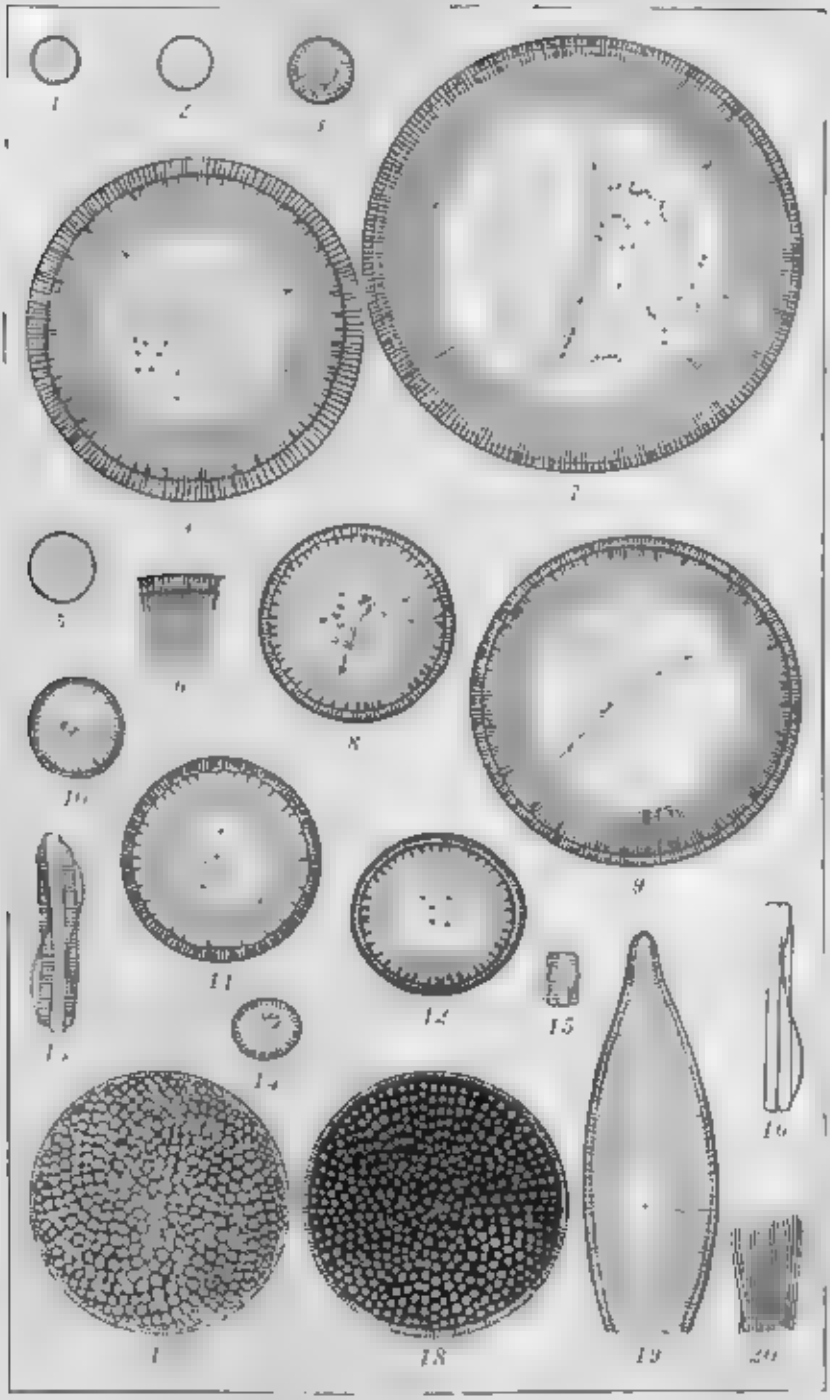

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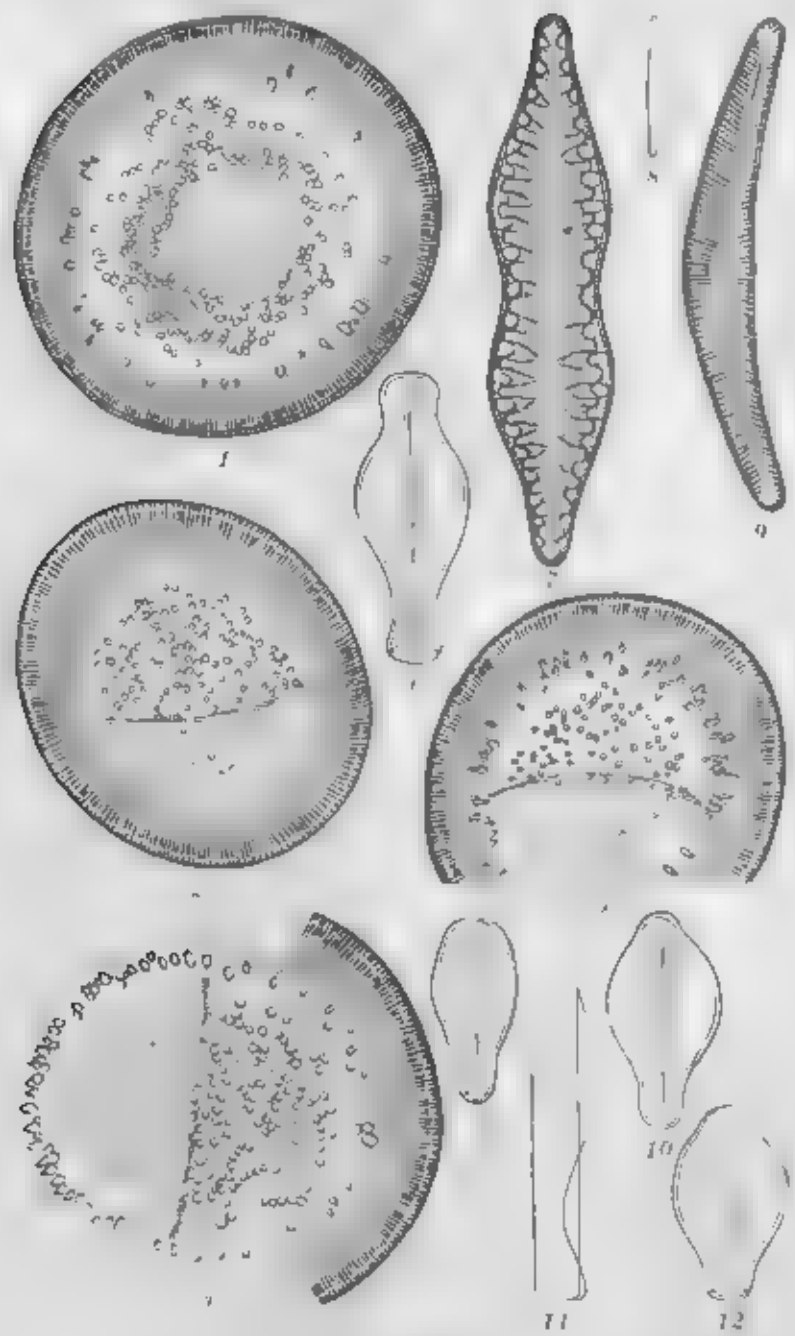

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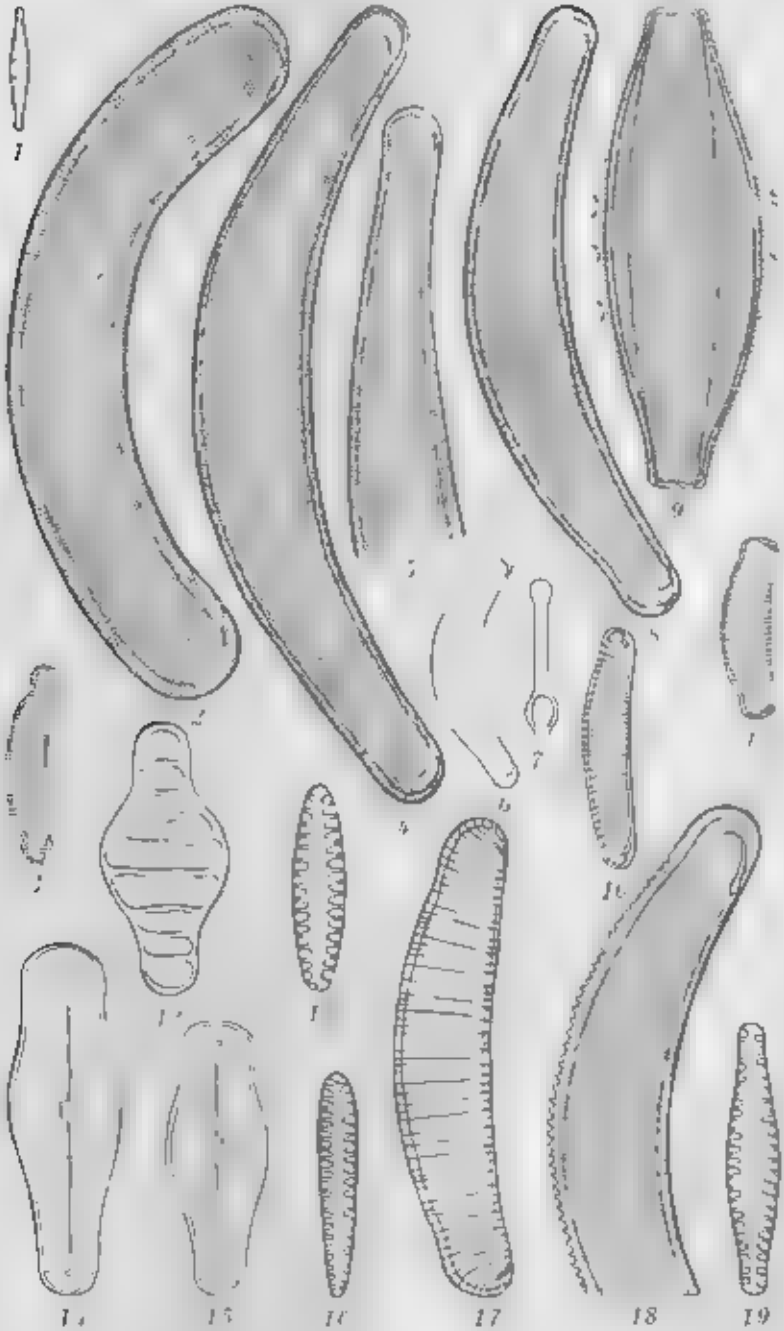

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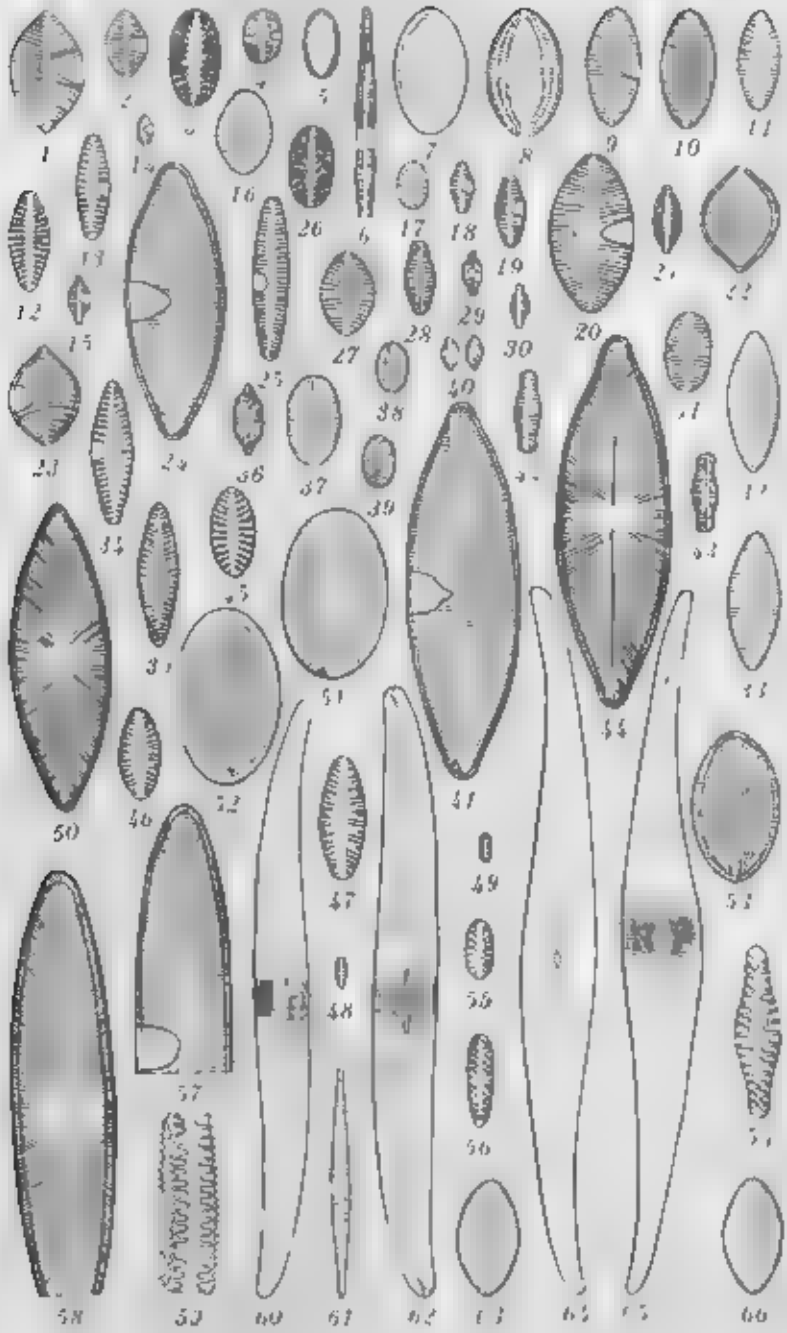

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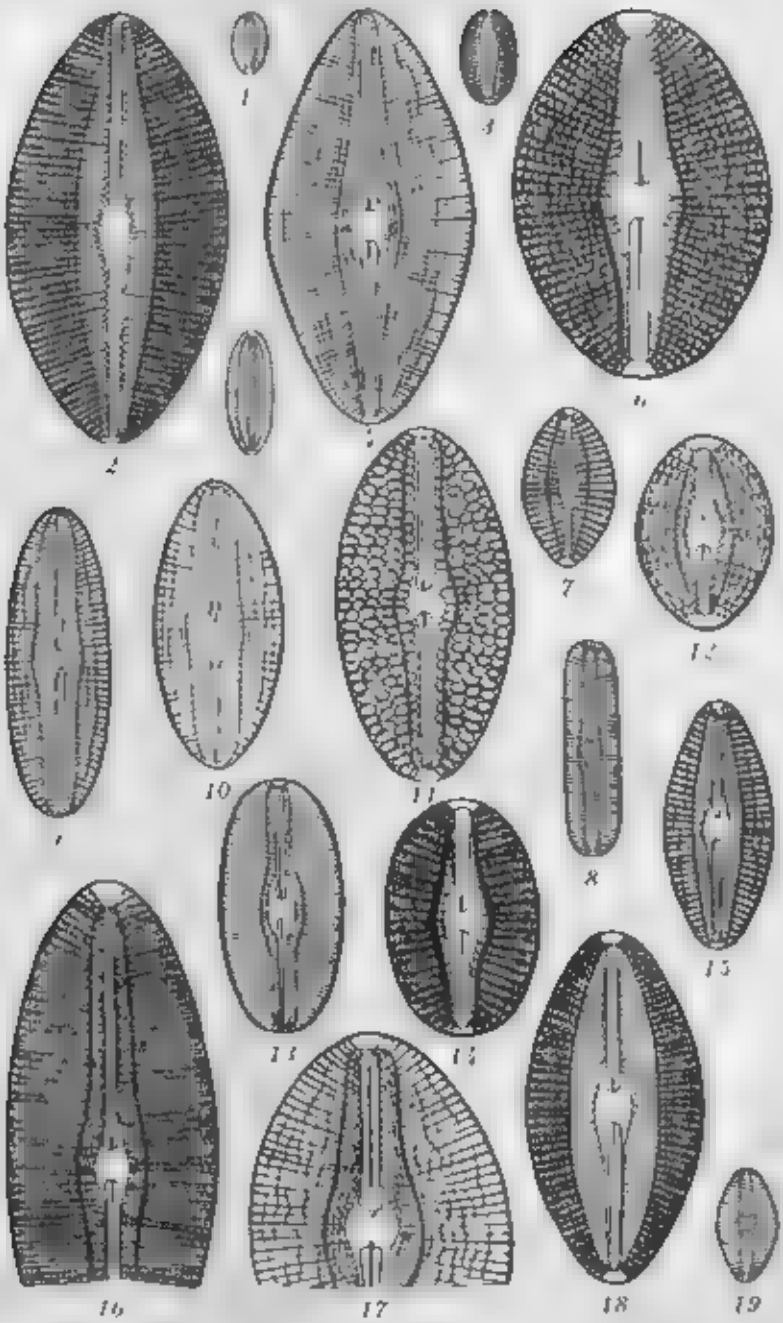
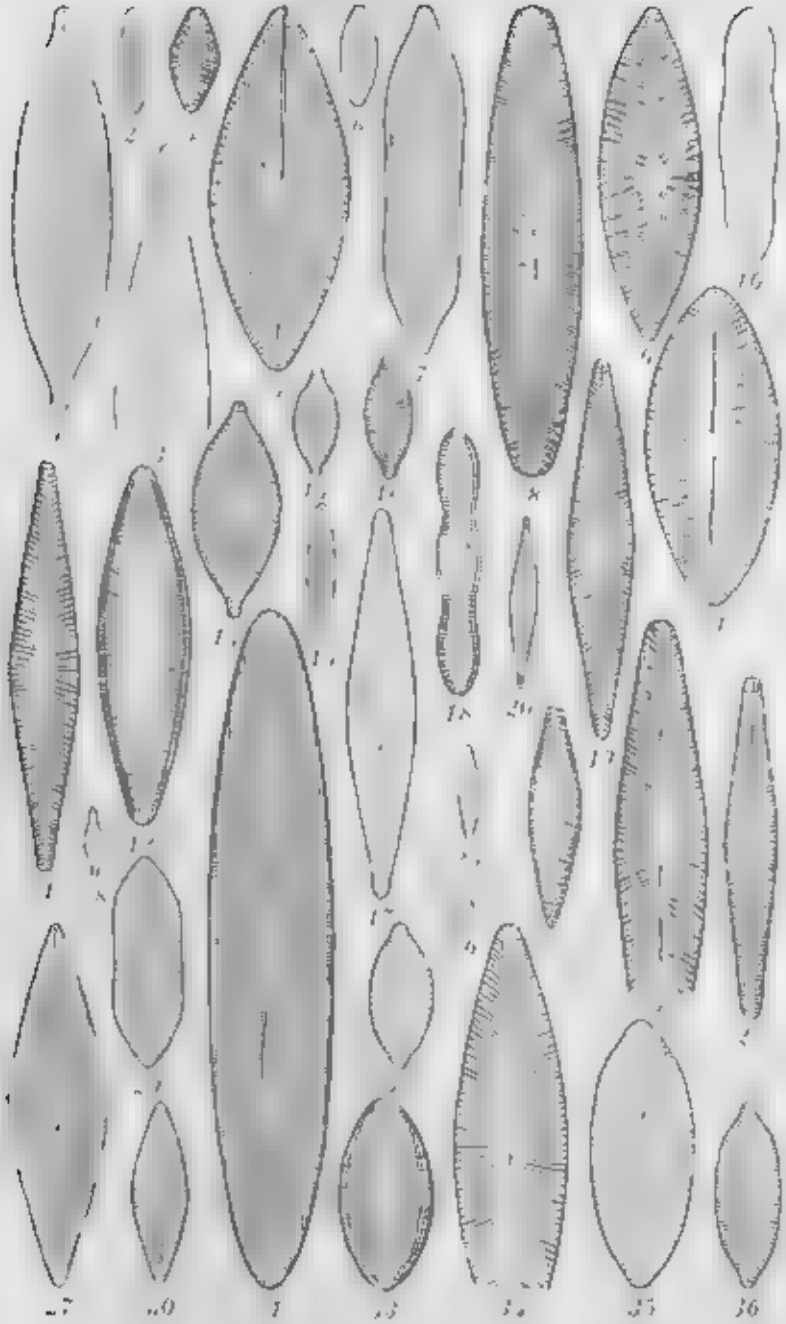


PLATE 6



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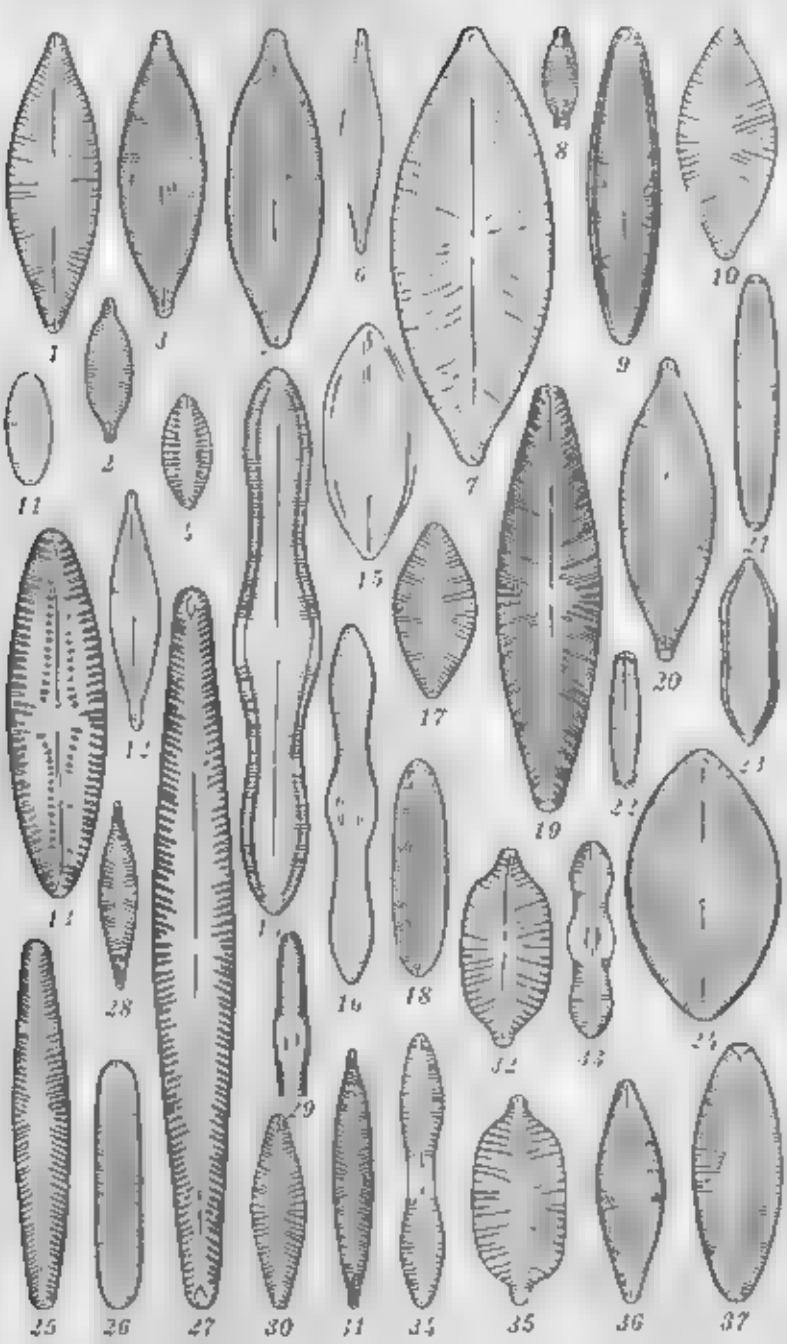
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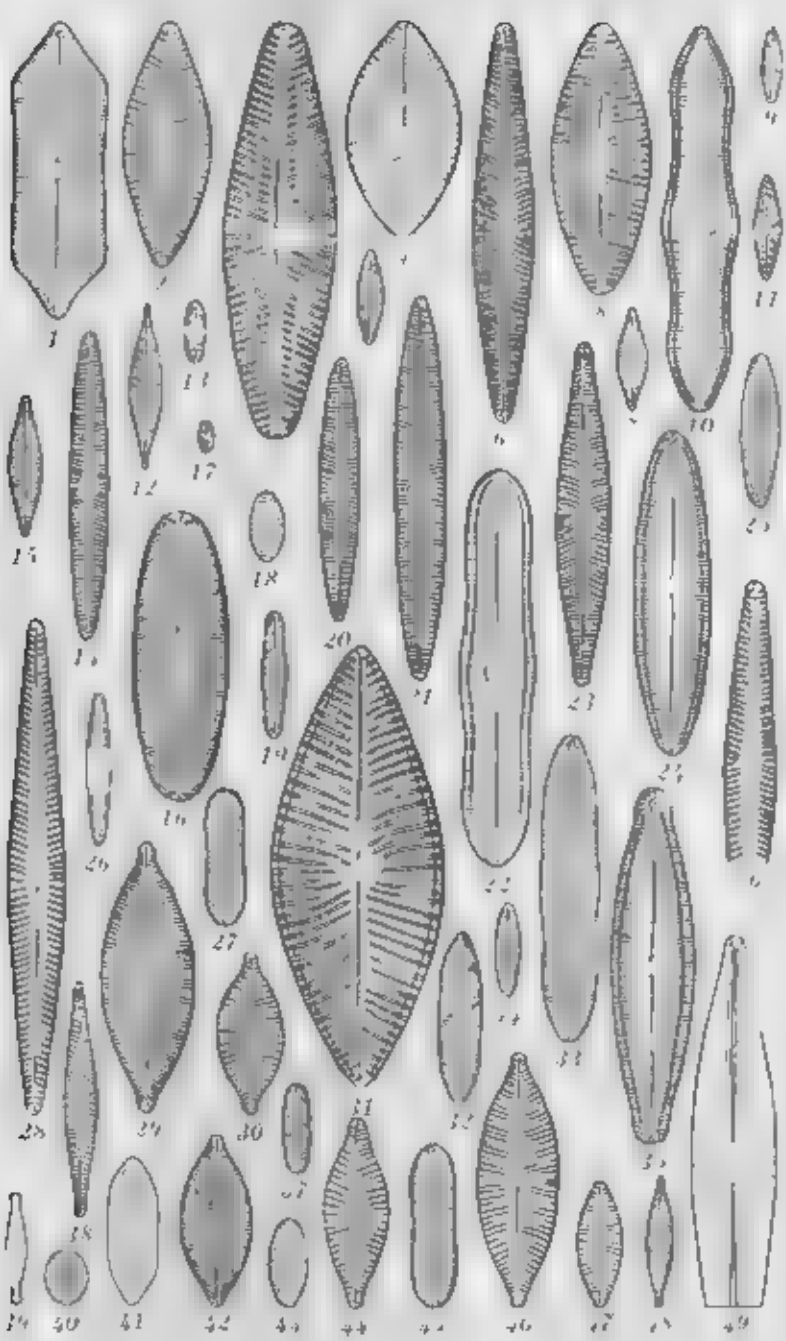
PLATE 8



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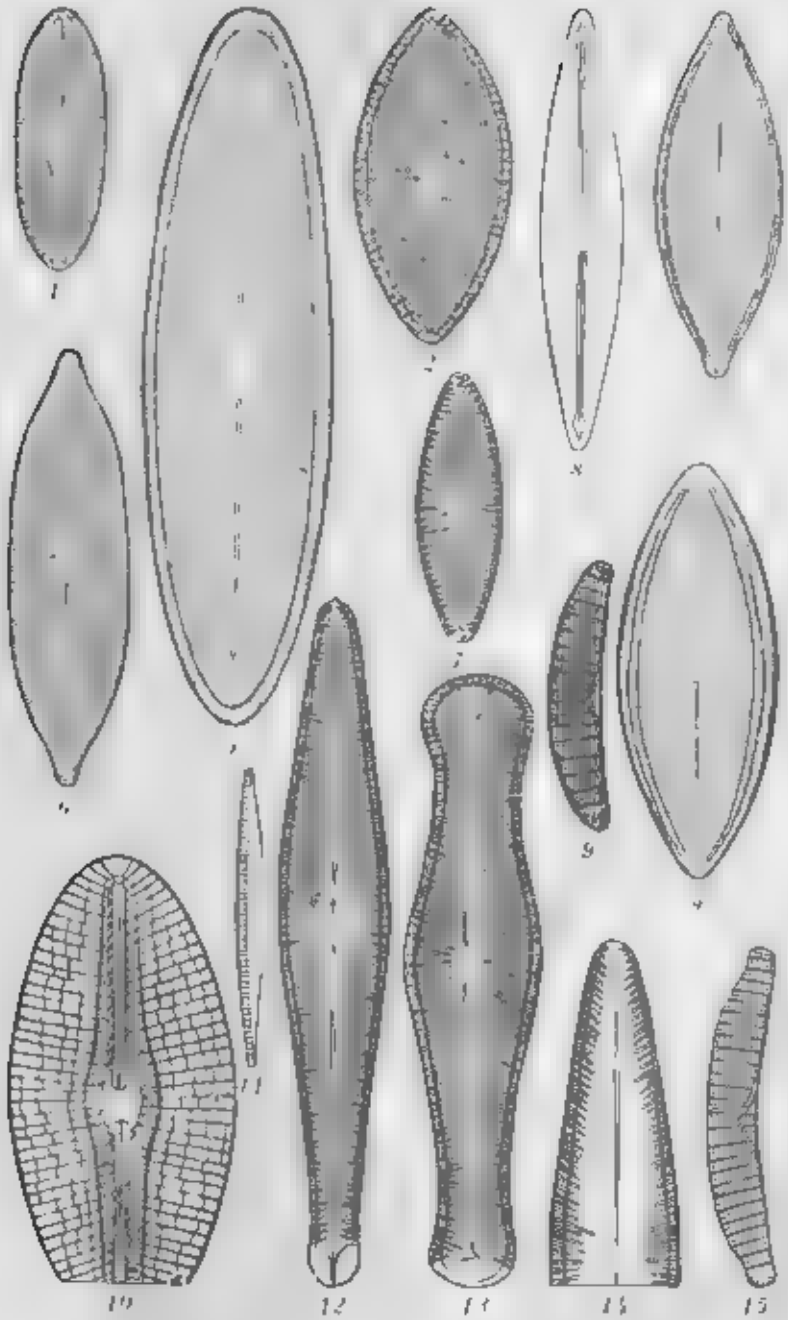

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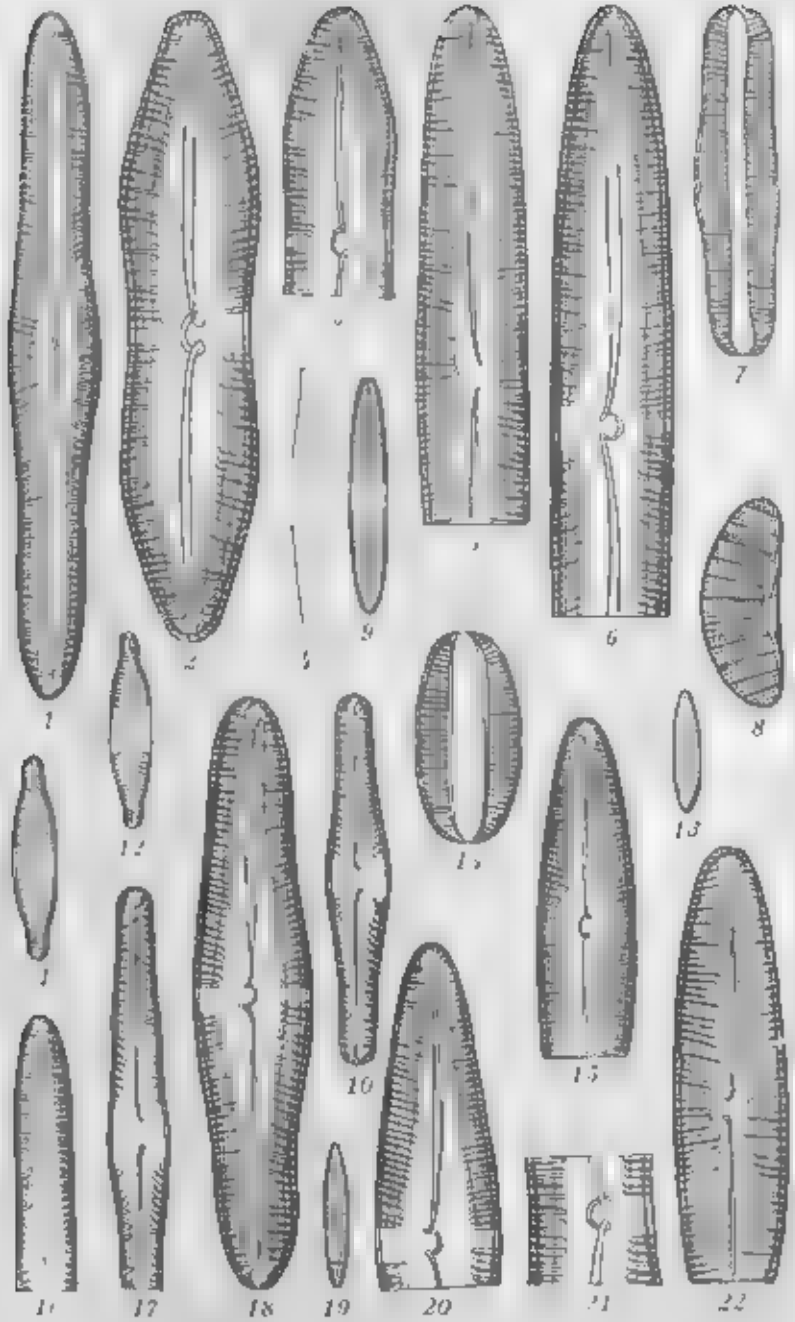


PLATE II

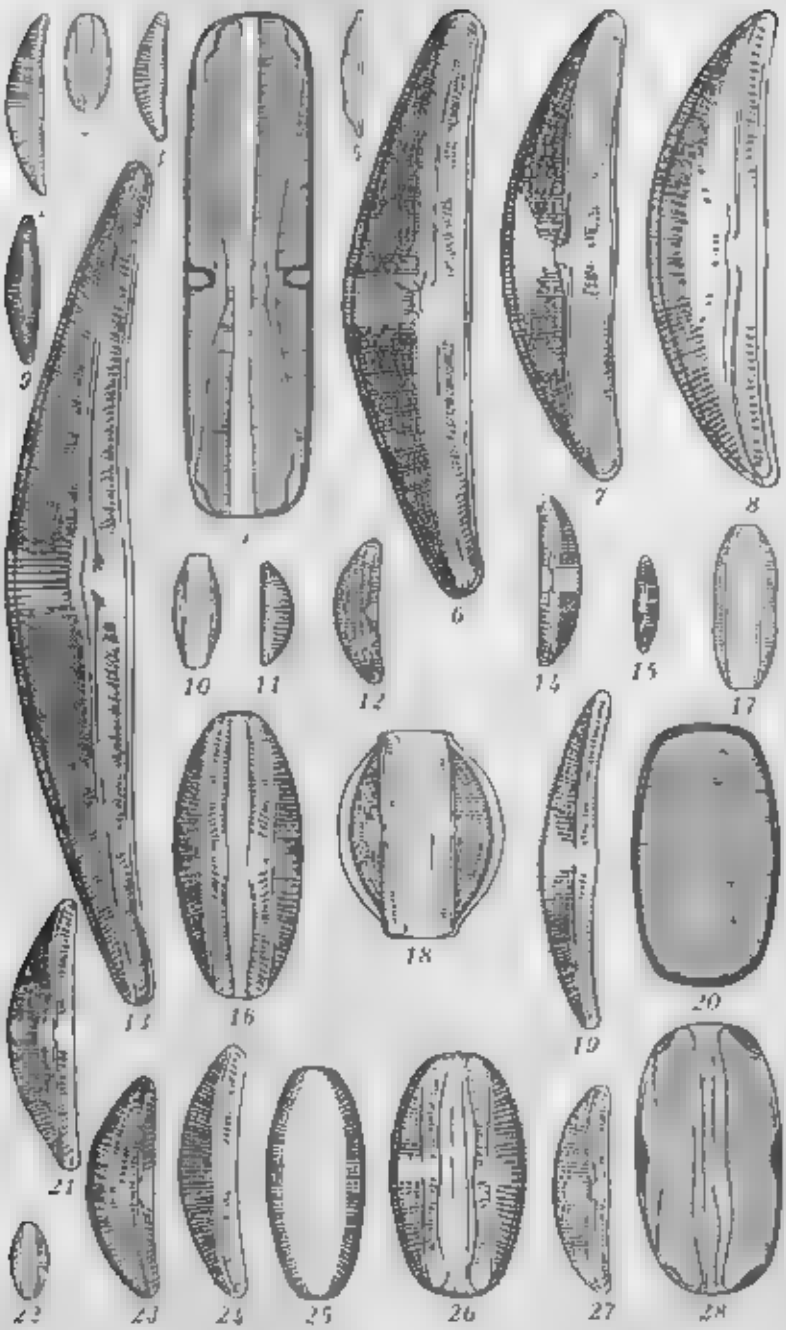
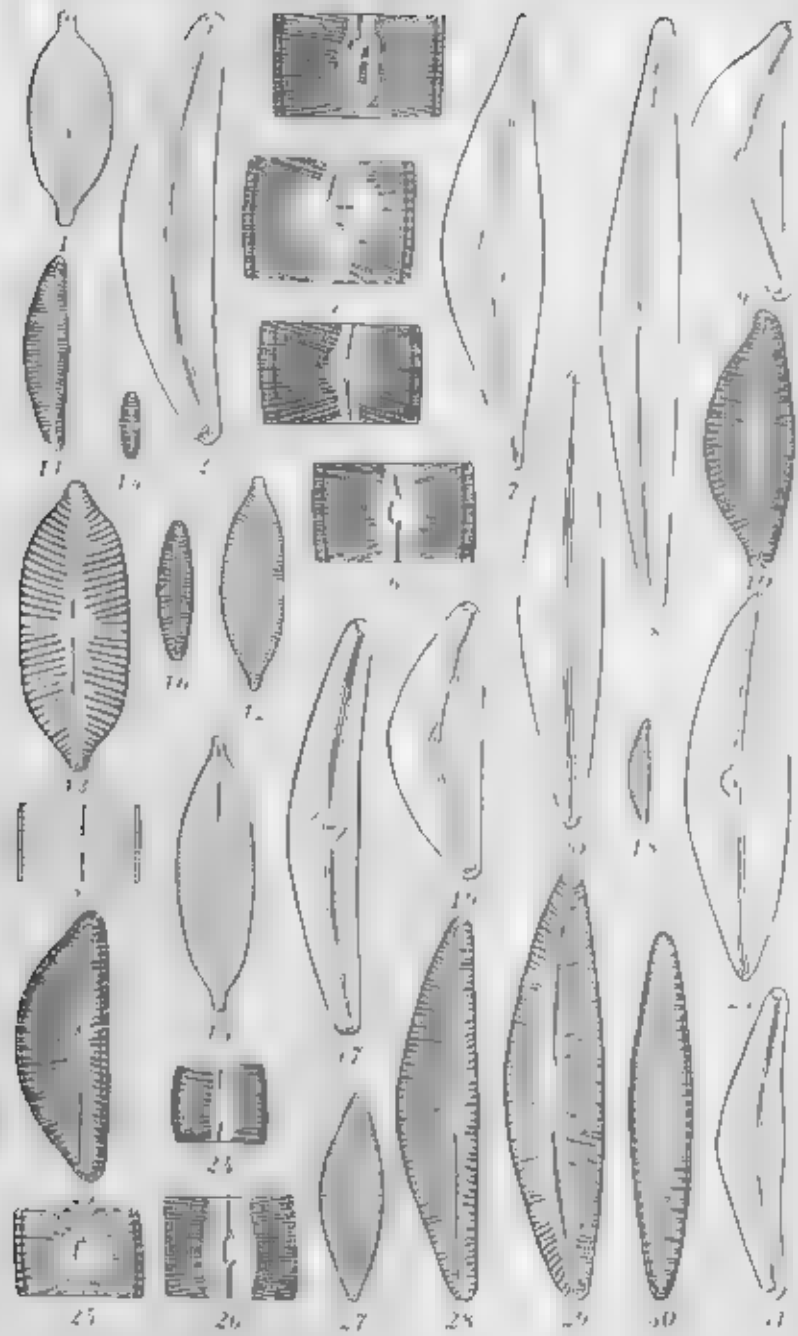


PLATE 13



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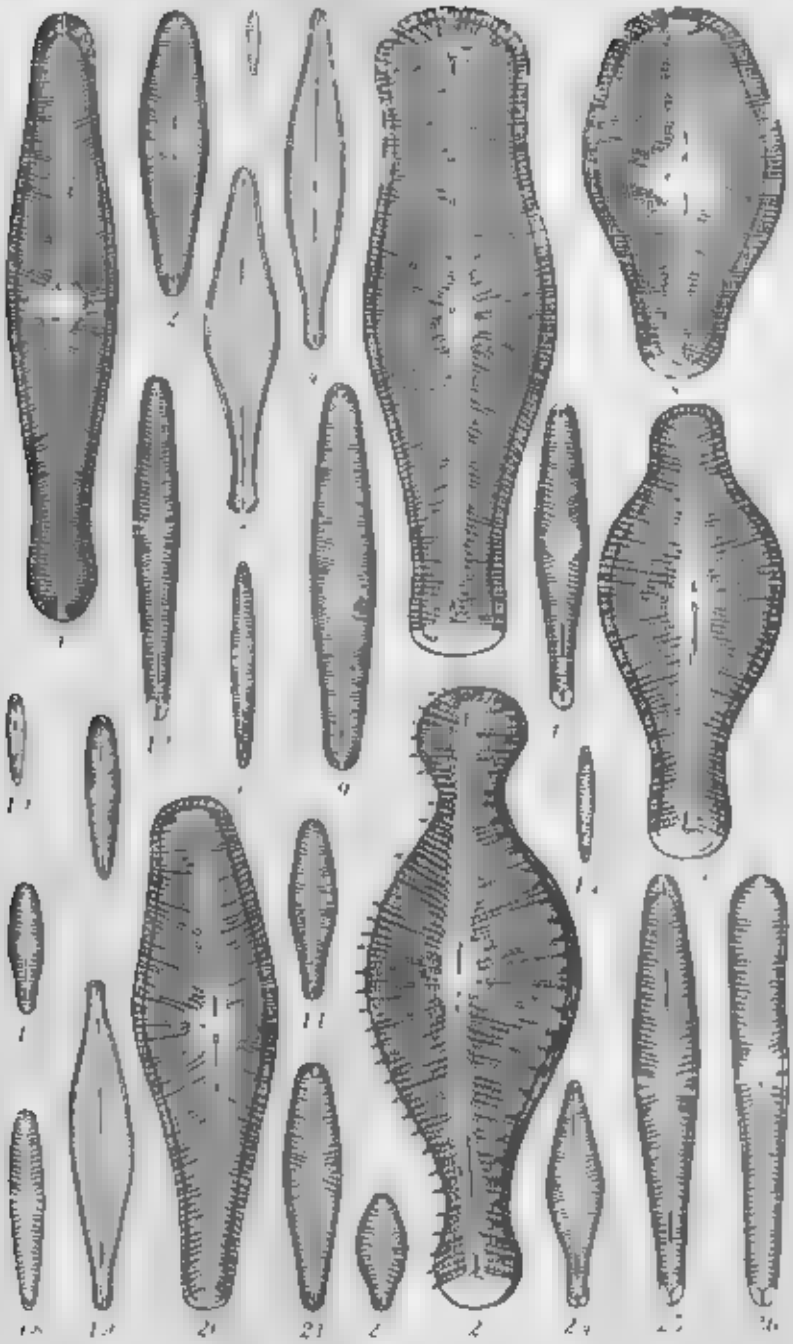
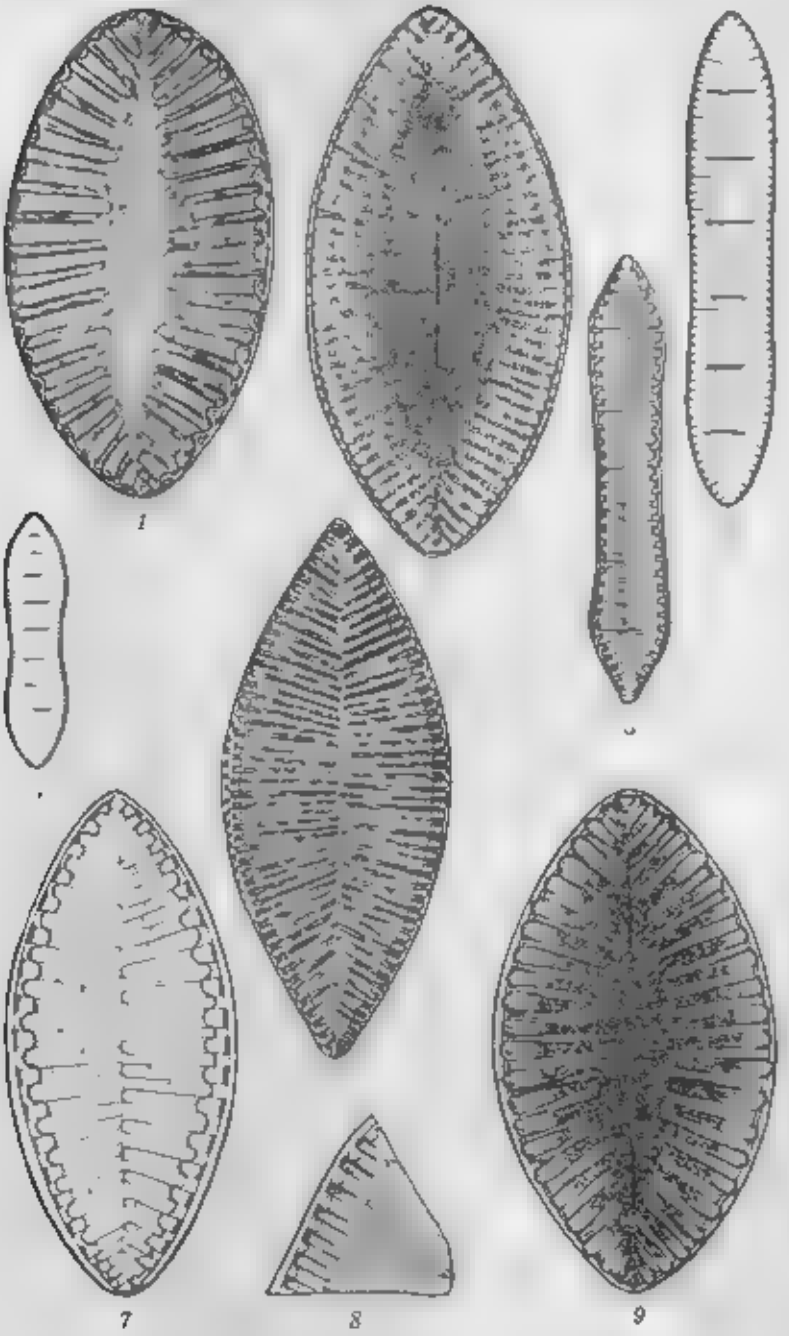


PLATE 14



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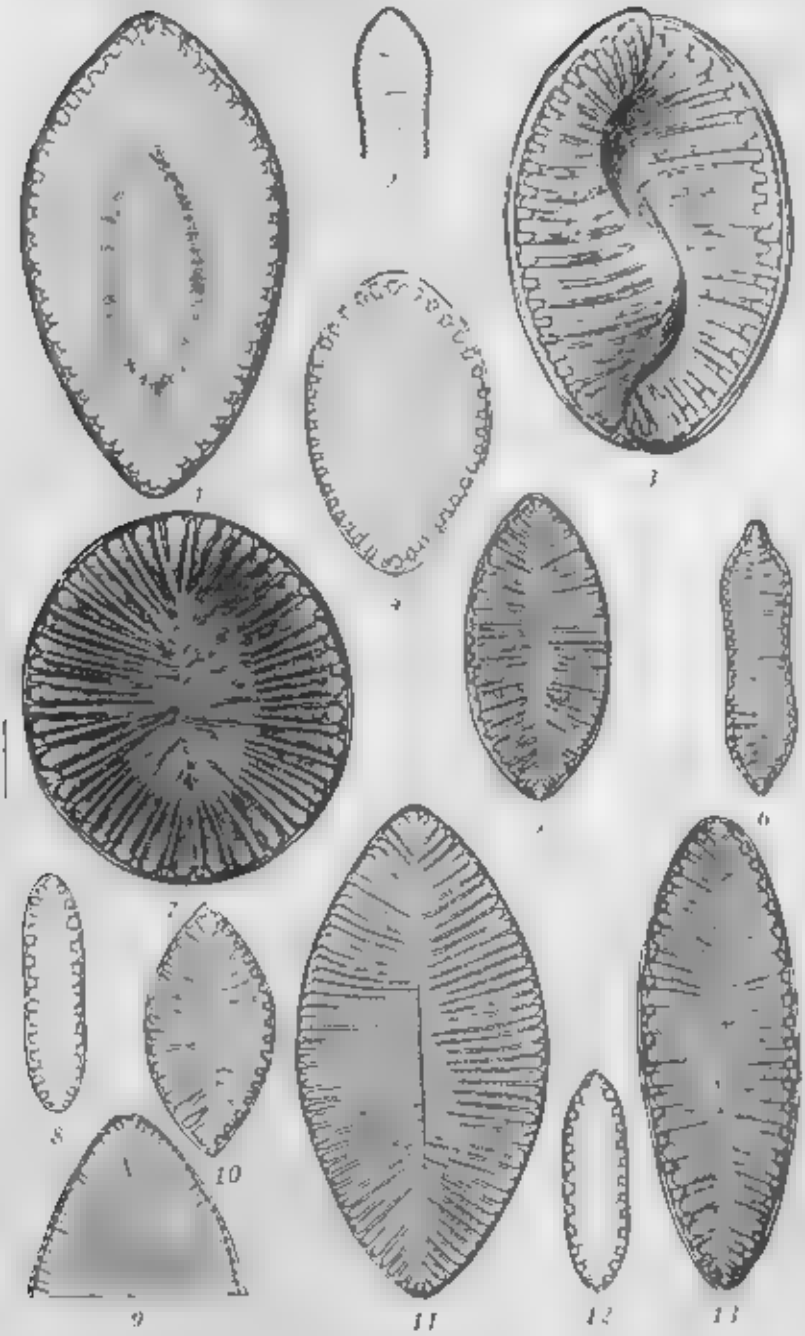

PLATE 18

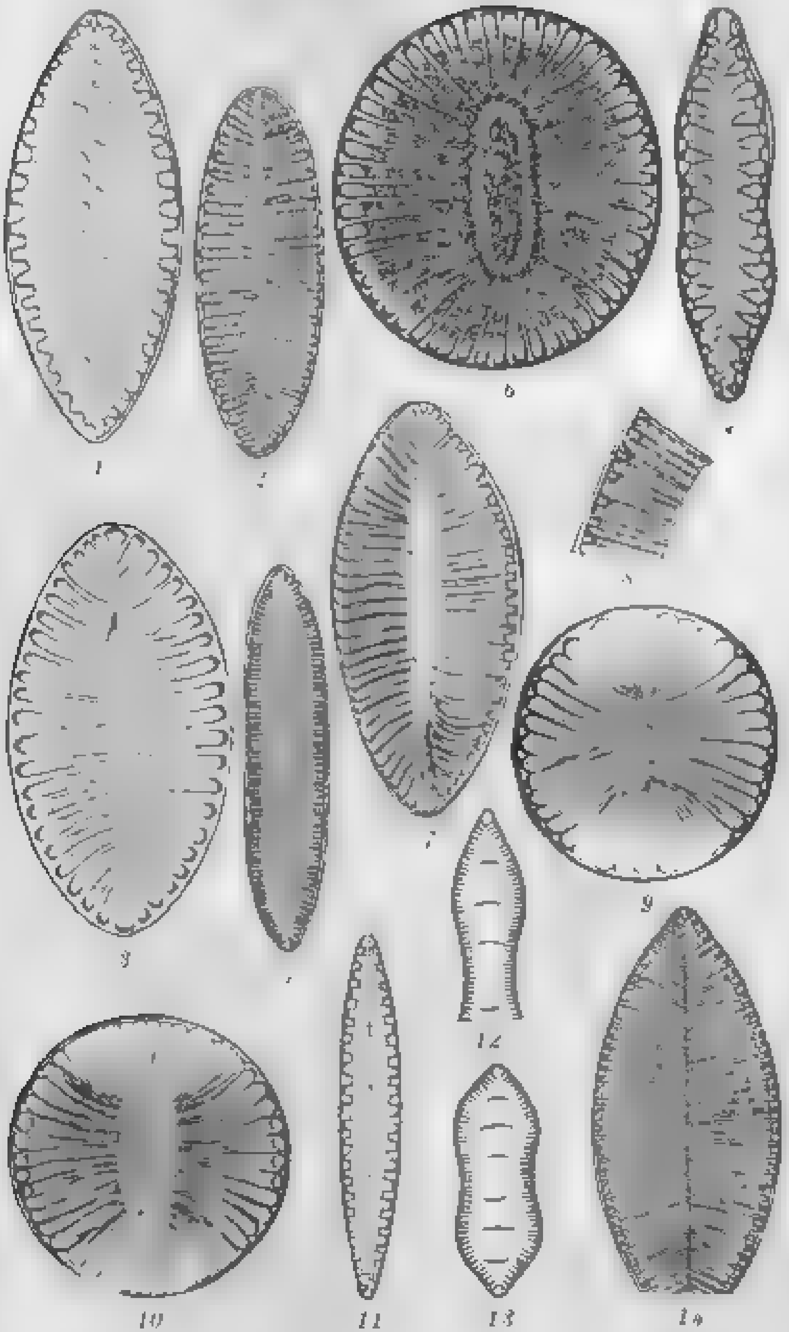

PLATE 17

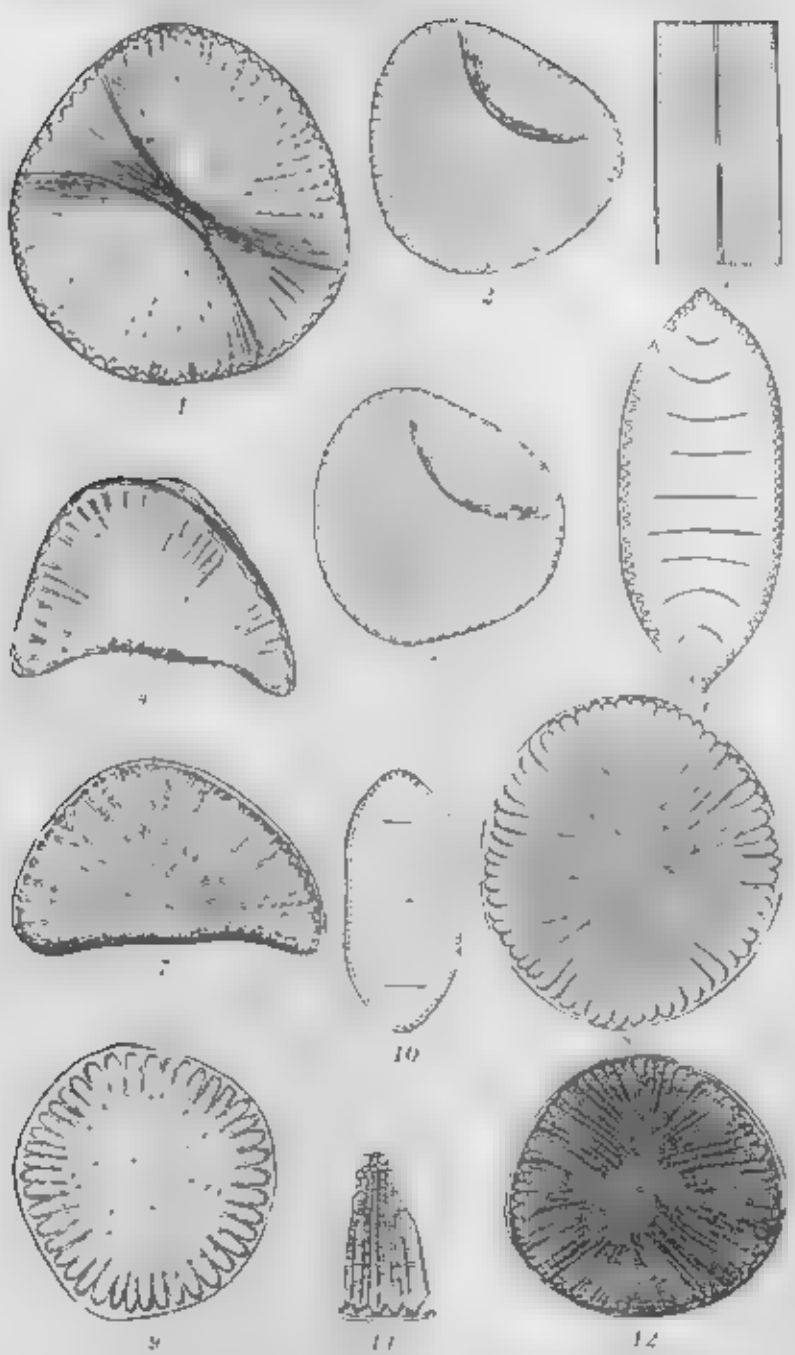

PLATE 48

BENEFICIAL SWIFTLET AND EDIBLE BIRDS' NEST INDUSTRY IN BACUIT, PALAWAN

By CANUTO G. MANUEL

Of the Fish and Game Administration, Bureau of Science Manila

THREE PLATES

Edible bird's nests consist of a gelatinous substance produced by certain birds known as swiftlets. These nests are built in limestone caves along the seashore in many parts of the Philippines. Their value as a delicacy and food for convalescents is well known to the Chinese. Since the early days of Sino-Filipino trade relations, local Chinese merchants have been exporting this product to China, and since then the business has remained entirely in their hands. In the Philippines the famous edible-nest soup can be obtained only in high-class Chinese restaurants. Although, according to Stresemann,(1) the Philippines is one of the countries known to export edible nests, very few Filipinos are aware of the existence of this article of commerce in their country, and there is no official record available on the bulk of this trade. According to Dammerman,(2) the Netherlands Indies in 1927 exported 109,310 kilograms of edible nests worth 822,913 guilders [1]

Among the places in the Philippines known for edible bird's nests are Bacuit, Coron, and Taytay, in Palawan Province, and Cagayan Sulu in the Sulu Sea. Of these localities only Bacuit derives a revenue from this industry as provided for in Act No. 3379 (see p. 884). This study was undertaken to determine the extent of the industry and the species of birds that build the edible nests in Bacuit. The actual field work was done with the assistance of Francisco S. Rivera, in Bacuit, Palawan, from April 13 to 29, 1936. Additional information was obtained from edible-nest stores in Manila.

The literature on edible nests is very limited. The writer is not aware of any article published in this country on edible bird's nests, or on the birds building them, that is of any scien-

[1] One guilder is equivalent to approximately 60 cents United States currency.

tific significance, except for the results of chemical analysis[6] for food value. Two investigators, however, Dr Alfred Worm, formerly of the Bureau of Science, and Mr. Antonio V. Perez of the Bureau of Forestry, were sent to Bacuit to study the condition of the industry, and their reports were used freely in this paper. The writer is, therefore, under obligation to these gentlemen.

IDENTITY OF THE BIRDS

Several notions have been held concerning the birds that build edible nests. Some people believed them to be swallows (1) It is now generally conceded, however, that edible nests are built by a swiftlet, belonging to the genus *Collocalia*, a bird far removed from the swallows. The specific identity, however, has baffled ornithologists. According to Sowerby(10) *Collocalia fuciphaga* (Thunb.), "the true edible swift," builds white nests. In the Philippines McGregor(8) cites Bourns and Worcester for the statement that *Collocalia troglodytes* Gray builds edible nests. The same statement appears in Hachisuka's description of that species (4) Recently Stresemann(11) contends that the races *germani*, *inexpectata*, *vestita*, *javensis*, *micans*, and some other neighboring forms of the species *francica*, appear more and more to be the producers of edible nests. The bird we caught on a white nest in a cave in Bacuit has the following description: upper surface somewhat with greenish metallic or olivaceous gloss on head, neck, back, and upper tail coverts; wings, dusky neutral gray;[5] a band across rump as in under surface, smoky gray with dark brown shafts; tarsi unfeathered. It has the following measurements: wing, 120 mm; longest rectrix, 51 mm, shortest rectrix, 44. The bird is known to the natives as *balasasapaw*.

This bird is identical with the swiftlets in the collection of the Bureau of Science, obtained from Cagayancillo and Cagayan Sulu islands, except for the color of the upper surface, which, in those from the latter islands, shows sign of fading. These birds were collected in 1901 and 1903. Incidentally, edible nests are known to occur in the last-named island. The meas-

[5] From Ridgway, R. Color Standard and Color Nomenclature. Washington, D. C. 1912.

urements of birds from Cagayan Sulu and Cagayancillo islands are as follows:

Locality	Sex	Wing	Longest rectrix	Shortest rectrix
Cagayan Sulu	♂	119	51	47
Do.	♂	119	49	42
Cagayancillo	♀	121	52	46
Do.	♀	120	50	44
Do.	♀	122	49	46
Do.	♂	120	49	44
Do.	♂	122	50	45
Do.	♀	121	49	43

These measurements conform with those of Oberholser's(9) and Stresemann's(11) *Collocalia francica germani* Oustalet.

While Oberholser(9) mentions the Philippines in connection with the geographical distribution of the race *C. f. germani*, McGregor(8) was more specific, mentioning Cagayancillo, Cagayan Sulu, Calamianes, Cebu, Negros, and Panay. Stresemann(11) only mentions the Mergui Archipelago, the coasts of Tenasserim, Peninsular Siam, and the Malay States to the south nearly as far as Johore as localities of this species, although he indicates Luzon and Palawan as localities for *C. f. vestita*, an allied race of *C. f. germani*. Inspite of these diverse views concerning its distribution, this edible nest builder of Bacuit, Palawan is allocated to *Collocalia francica germani* Oustalet.

HAUNTS AND HABITS OF THE SWIFTLET

The Municipality of Bacuit is situated on the west, near the northern limit of the island of Palawan. It has several smaller islands under its jurisdiction that are lying close to the mainland of Palawan. All these islands are characterized by limestone rocks, the remnants of a vast coral formation of prehistoric times. In these rocks are caves, some of them opening on very steep cliffs. Edible nests have been gathered at the following islands: Cadlao, Cauayan, Dilumacad, Inambuyod, Taplutan, Lagen, Malpacao, Matinloc, Miniloc, and Inabuyatan. The exact number of caves in these islands, has, so far, not been determined; people of Bacuit interested in bird's nests estimated more than a thousand in the whole municipality. The size, depth, and direction of the caves vary, ranging from small ones

inhabited by about 20 pairs to large ones the number of inhabitants of which has not been determined. A *baccador* (nest collector) informed the writer that the rocks in the mainland of Bacuit proper are provided with a system of tunnels by which an experienced gatherer can enter any of the cave openings and go out by another way.

The walls of the caves are characterized by convexities, concavities, and protuberances. Their surfaces, however, are smooth, due perhaps to the action of water that has flown over them in the past. Generally the nests are attached to the upper end of a concavity, where they are safe from the birds that go in and out of the caves. The source of the nest materials has been much discussed, and the theories suggested by Green,(3) namely, algæ, fish spawn, and secretions of the swiftlets themselves, have narrowed down to the third. It is now generally admitted, on the basis of studies by Green,(3) Heiduschka and Graefe,(5) Krukenberg,(7) Wang,(13) and others, that the nests are made of substances from the salivary secretions of the birds themselves. In shape the nest may be compared to one side of a boat cut longitudinally at the bottom. Stuart Baker(12) describes the nest of a *Collocalia francica* as "of pure white semitranslucent inspissated saliva, half-cups stuck up against the sloping roofs of small caves round the coast." He also said that it looks like a half saucer of fine strings of isinglass, all matted and half matted together. It presents two surfaces, two edges, and two ends. The surfaces are concave inside and convex outside, while the edge stuck against the wall is thicker than the opposite outer edge. The two pointed ends are drawn upward and slightly inward. A completely built nest weighs about 7 grams,[1] but a complete nest is very rarely collected.

Two types of nests are found in the same cave. Because of their color they are grouped into white and brown nests, or first and second-class nests, respectively. Several suppositions exist concerning these nests. It is believed that the secretion is normally white. Repeated poaching of white nests, however, results in the exhaustion of this white secretion, and the inferior brown nests are later produced. Another supposition is that the brown color of the nest is due to age. It is also believed that the white and brown nests are built by distinct species of swiftlets. The *baccadores*, or nest gatherers, of Bacuit, how-

[1] The weight was obtained a few days after collecting, as practiced in Bacuit.

ever, are unanimous in the opinion that the brown nests are obtained in very deep parts of the cave in the same colony where the white nests are secured. The color, according to them, is due to the soot of the torch which cannot escape. It is thus obvious that brown color is also largely due to age; older nests being subjected to more soot than newer ones. According to the collectors repeated gathering of the nest does not disturb the bird much, for in exactly the same place a new nest of the same nature is constructed. In other caves, however, *Collocalia marginata* were collected. Their nests are of no commercial value, as they largely consist of dark mossy materials held together by a scanty gelatinous substance. This nest and the bird that builds it are known to the natives as *cula cula*.

During the period in which the species was under observation, no eggs were obtained, as the nests were continuously collected. For this reason no authentic description of the egg can be given here. According to the collectors, however, two white eggs comprise the full complement.

In Bacuit *Collocalia francica germani*, the swiftlet that builds edible nests, can readily be distinguished from other forms by its movements. As soon as it leaves the cave the tendency of its flight is upward, whereas other swiftlets either come lower or fly in the immediate neighborhood of the cave. This tendency of the edible-nest builder makes it extremely difficult to secure specimens of this species. In the early morning and the late afternoon, however, thousands of the other species of swiftlets can be seen flying close to the ground.

EDIBLE-NEST INDUSTRY IN BACUIT

GOVERNMENT PARTICIPATION

Collecting birds' nests has been a source of livelihood of many people in Bacuit for as long as the residents can remember. Previous to the year 1919 the municipal government of Bacuit recognized the right of any claimant of a cave or caves. The exclusive right of the owner to the nests in his caves was an unwritten law. The period of ownership was indefinite, in fact, ownership came to be handed down from generation to generation. The owner of the caves could sell to anybody the right to collect the nests in his caves. The collector, on the other hand, whether he may be the owner or not, paid the municipal government an annual license fee of 50 centavos.

The nests collected were sold to the local dealers. The business became very lucrative, giving rise to competition among local dealers. As a consequence this condition, which had existed for generations, ceased in 1919 when the provincial board of Palawan passed an ordinance affecting the edible-nest industry. A proviso granting the exclusive privilege of gathering edible birds' nests under a municipal license was adopted. This ordinance was the nucleus of Act No. 3379, otherwise known as "An Act Authorizing Municipalities or Municipal Districts to Impose License Taxes on or Let the Privilege of Gathering Edible Nests Therein, and for other purposes" passed by the Philippine Legislature December 3, 1927. Section 1 of this Act provides that:

> Municipalities or municipal districts shall have authority, within their respective territorial jurisdiction, to impose municipal license taxes on the privilege of collecting edible birds' nests at rates fixed by ordinance of the council, or to grant the exclusive privilege of gathering edible birds' nests in accordance with the provisions of the general municipal law concerning the letting of fisheries and municipal public utilities. Provided, That this authority shall not be interpreted as empowering said municipalities to regulate the establishment of a close season for the collection of edible birds' nests or to prescribe rules and regulations for the preservation of the lives of such birds and the industry itself, which, by law, is vested in the Secretary of Agriculture and Natural Resources (See regulation elsewhere in this paper)

This ordinance introduced a new phase in the industry. The traditional ownership of caves was given up. The collector's license fee was discontinued. Instead, the municipality of Bacuit gives the exclusive privilege to the highest bidder. The amount obtained from the bid is the revenue that the municipality of Bacuit now derives from the edible-nest industry.* Among the conditions in the rights of the concessioner is that all collectors of edible nests must turn over to him the nests collected within the territorial jurisdiction of the municipality of Bacuit. For some time the ordinance provided a good income to the municipality, as local dealers were in competition. In 1927 Mr. Joaquin Vasquez, of Bacuit, wrote the late Doctor Worm that the municipality derived 1,700 pesos annually from this industry. Later however, the dealers, all Chinese, formed a corporation and thus eliminated competition. They run their own store in Manila. As a result the bid in 1932 was 575 pesos.

* Before this paper went to press, news was received that traditional ownership was restored as nobody submitted a bid for 1937.—C. C. M.

the amount imposed by the municipality as the minimum acceptable. In 1936 the bid was 500 pesos. Whether this decrease in revenue is accompanied by a corresponding decrease in the number of nests collected cannot be ascertained, although on one occasion the concessioner intimated to municipal officials that the annual yield of nests had been increasing. There is no provision in the ordinance in force to enable the municipal authorities to determine the annual yield of the nests. The writer was unable to obtain information about the annual yield of nests, as the concessioner would reveal nothing with regard to this and similar matters. In 1932 A. V. Perez, who stayed in Bacuit for a number of years as Forest Officer in charge, reported that from four islands alone about 420 kilograms of edible nests are collected every year. A rough estimate of 500 kilograms of edible nests from all the islands is considered very conservative. At an average weight of about 5 grams per nest approximately 100,000 nests are collected every year in Bacuit. There is a general feeling in Bacuit that if anyone had been allowed to bid against the corporation now holding a monopoly, the amount collected by the municipality would have been much greater, and the prices paid to the collectors would be higher. A number of residents contemplated participating in the bidding, but were hindered by their unfamiliarity with the business.

THE COLLECTOR AND THE METHOD OF COLLECTING

Under the present arrangement the number of *boceadores*, or nest collectors, cannot be determined. Anybody can be a collector. The concessioner receives all the nests gathered in the caves. This system has often been the cause of trouble among the nest collectors. Poaching or stealing nests by one *boceador* in a cave watched by another is a general occurrence, as the concessioner unquestioningly accepts all nests offered to him. Trouble usually arises in the following manner. When the rain ceases in December the collectors secretly enter their caves to prepare them for the ensuing season. Old nests are collected and the walls of the cave are cleaned to insure an entirely fresh crop. Occasionally old nests are used for commercial purposes. On or about the first week of January the swiftlets begin to build nests. As it takes about three or four weeks to complete a nest, the *boceador* knows that heavier nests can be gathered during the last days of January. Poachers, however, enter caves before that time and collect the nests ahead of the owner. On several occasions the concessioner had to intervene to settle amicably trouble arising under such circum-

stances, especially if the cave owner had come upon the poacher in his cave.

The collection of bird's nests is difficult and risky. A. V. Perez says in his report: "The collection of edible birds' nests is an admittedly hazardous enterprise, in which the collector, known locally as *baconador*, risks his neck, his limbs, and even his life. Only a few caves are easily accessible, and such caves are devoid of bird population Most of the caves are reached only by painful and patient crawling, inch by inch to reach a ledge, then jump across some deep chasm or ravine, filled with sharp pointed rocks. Some of the caves are on the perpendicular faces of cliffs rising sheer out of the sea. Such caves are entered into after a painful and dangerous climb to the top, after which the collector lowers himself into the cave hand over hand on the rope."

The collector on entering a small cave oftentimes has to use both feet, one or both hands, and his back, to provide anchorage against certain portions of the wall where there is nothing to stand on. A lighted stick of almaciga[1] is used as a torch.

RELATIONS BETWEEN CONCESSIONER AND COLLECTOR

There is a very intimate relationship between the concessioner and the collector, to whom all nests gathered are turned over. Immediately upon collection the collector submits his nests to the concessioner who, as far as residents can remember, always maintains a store of general merchandise. The nests are kept in the possession of the concessioner who takes care of the drying. After a few days, when the nests are almost entirely dirt- and moisture-free, before they are tied together into small bundles (Plate 3) of about 100 grams each, the concessioner calls the collector and either tells him the weight of the nests he collected or weighs the nests in his presence. According to the quality of the nest, which is decided by the concessioner, it costs from 2 to 3½ centavos per gram. In 1927 Doctor Worm noted the price at 5 centavos a gram As all the collectors are heavily indebted to the concessioner for merchandise, no cash is involved in the transaction. As a gram of edible nest in Manila costs from 7 to 9 centavos, the margin of profit is considerable. The concessioner justifies this high margin of profit by the following considerations: (*a*) He pays 500 to the municipality for concession rights. This fee is payable in advance, in the face

[1] A resin of the almaciga tree (*Agathis alba*).

of uncertainty about the yield for the year (*b*) He pays a sales tax of 1½ per cent. (*c*) He pays for the shipping. (*d*) He furnishes long-time credit to collectors for the goods they obtain from his store throughout the year and, as many collectors cannot pay him, several thousand pesos of his capital is tied up. (*e*) The price he can obtain in Manila is uncertain.

CONSERVATION: LEGAL AND NATURAL

In an industry like that of edible bird's nests laws and regulations for the conservation of the producing species should be a primary consideration. The collector bent on collecting everything for himself is not concerned with what might happen to the generations to come. Moreover, he is perhaps unaware that intensive nest gathering may result in the extinction of the species that provides him his living. Likewise, the concessioner is not interested in the yields for the years to come. He needs all the nests that the collectors can sell him to justify his investment. It is, therefore, up to the government to provide laws and regulations to perpetuate this important property of the land.

Pursuant to the provisions of Act No. 3379, the Department of Agriculture and Natural Resources on May 19, 1932, issued Administrative Order No. 29–1, regulating close seasons for certain species of birds and mammals. Paragraph 6 of this order reads:

> For birds that make edible nests and edible birds nest,—the period from April first to June thirtieth, inclusive, of each year, *Provided, however*, That during the open season edible birds' nests shall be taken under license duly issued in accordance with Act No. 3379, and that no person or persons shall take, sell, purchase, or have in possession any such nest of less than ten grams weight.

Before the enactment of Act No. 3379, the Municipality of Bacuit had already recognized the necessity of a close season for the collection of birds' nests. The months of May and June were set aside as close season. There was no provision for the size or weight of the nest to be collected. According to many informants, however, the ordinance was not strictly enforced. Poaching was very common. With the enactment of the law, the power to regulate the close season and the prescription of the rules and regulations were turned over to the Department of Agriculture and Natural Resources, now the Department of Agriculture and Commerce. The order quoted

above, prohibiting even the keeping in possession of nests less than 10 grams in weight, must be violated openly, inasmuch as it is very rare to encounter nests weighing 10 grams or more in the possession of the concessioner. It is obvious that the prescribed regulation refers to the weight of the nest at the time of collecting. In any event the defeat of the "weight provision" is evident. This is perhaps one of the reasons of the municipal officials' indifference to enforce this order. As a result the *boceadores* are following the old ordinance, with a close season only in May and June, without being apprehended. It is, therefore, necessary that an understanding should be reached between the insular and municipal officials in order that existing rules and regulations should be enforced. Fortunately, in spite of the nonenforcement of the present laws and regulations the species has been holding on. The concessioner and some other people in Bacuit even contend that the number of nests collected has increased from time to time. A natural factor for the perpetuation of the species was discovered by the late Doctor Worm. The presence of many small cave openings in very dangerous cliffs (Plate 3, fig 2) have saved the industry from being ruined. Collectors do not dare enter these caves in spite of the fact that thousands of these birds are seen going in and out. Records of persons who dared enter these caves and were killed there are fresh in the minds of many residents, and cause the collectors to fear entering the valuable caves.

SUMMARY AND CONCLUSIONS

1. The swiftlet that builds edible nests in Bacuit, Palawan, is *Collocalia francica germani* Oustalet.

2. This swiftlet builds its nest in caves. There are many of these caves in the limestone rocks that characterize several islands under the jurisdiction of the municipality of Bacuit.

3. The size of caves varies from small ones inhabited by about twenty pairs of swiftlets to large ones whose occupants have not been determined.

4. The walls of the caves are provided with convexities, concavities, and protuberances. Their surfaces however, are smooth.

5. Generally, nests are attached against the upper end of a concavity.

6. In shape a nest may be compared to a boat cut lengthwise at the bottom. A complete nest weighs about 7 grams a few days after collecting.

7. Two types of edible nests are obtained in the caves of Bacuit, white and brown, the latter being found in very deep caves. The brown color is due largely to age.

8. In some caves are found only nests of another swiftlet, *Collocalia marginata* Salvadori, called *cuda cuda* by the natives of Bacuit. These nests are not valuable.

9. By its flight, which is upward from the cave opening, *Collocalia francica germani* is distinguished from other swiftlets by the natives.

10. Collecting nests has been a source of livelihood to many residents of Bacuit, since time immemorial.

11. Previous to 1919 traditional ownership of caves by certain families was respected. Each collector paid the municipality 50 centavos annually for a license.

12. In 1919 a provincial ordinance was passed, declaring all caves government property and empowering the municipal government with granting exclusive privileges of collecting edible nests to the highest bidder. This became a law known as Act No. 2379.

13. Since then the revenue derived by the municipality for exclusive privileges has decreased from 1,700 pesos in 1927 to 500 pesos in 1936.

14. Approximately 500 kilograms of edible nests, or about 100,000 nests, are gathered from the caves within the territorial jurisdiction of Bacuit every year.

15. Poaching of nests is rampant and very often causes trouble among *boceadores* or nest collectors.

16. The collection of birds' nests is difficult and risky.

17. An intimate relationship exists between the concessioner and the nest collectors. No cash is involved in the edible nest industry in Bacuit. The concessioner owns a store of general merchandise and supplies the collectors' needs throughout the year. The concessioner determines the price of the nests turned over to him and balances it against the goods he supplies the collector. In 1927 the concessioner paid 5 centavos a gram; in 1936 the price ranged from 2 to 3½ centavos.

18. Due to lack of a definite understanding between the insular and the Bacuit municipal governments the existing rules and regulations for the protection of the species are not enforced.

19. Cave openings situated in very dangerous cliffs provide natural protection for the species and the perpetuation of the edible-nest industry in Bacuit, Palawan.

LITERATURE CITED

1. Anonymous. Edible birds nests. China Journ. Shanghai 2 (1924) 571
2. Dashermann, K. W. Preservation of wild life and nature reserves in the Netherlands Indies. Bull. Fourth Pacific Sci. Congress (1929) 86–87.
3. Green, J. R. The edible birds-nest, or nest of the Java Swift (Collocalia nidifica) Journ. Physiology 6 (1885) 90–45.
4. Hachisuka, M. The birds of the Philippine Islands with notes on the mammal fauna. Part 3 (1934) 180.
5. Heidelschka, A. und L. Graefe. Über essbare Vogelnester. Biochem. Zts. 260 (1933) 406 413.
6. Hermano, A. J. Food values. Bur. Sci Pop. Bull. 16 (1932) 39.
7. Krukenberg, C. Fr. W. Weitere Mittheilungen über die Hyalogene. Zts. Biol 22 (1886) 261–271
8. McGregor, R. C. A Manual of Philippine birds. Manila. Part 1 (1909) 355.
9. Oberholser, H. C. A monograph of the genus Collocalia. Proc Acad. Nat. Sci., Phila 58 (1906, 201.
10. Sowerby, Arthur de C. The edible birds' nest swift. The China Journ. 14 No. 3 (1931) 135–137, 2 pls.
11. Stresemann, Erwin Notes on the systematics and distribution of some swiftlets (Collocalia) of Malaysia and adjacent subregions. Bull. Raffles Mus. No. 6 (1931) 83–101.
12. Stuart Baker, E. C. The fauna of British India including Ceylon and Burma. Birds 4 (1927) 851.
13. Wang, Chi Chie. The composition of Chinese edible birds' nests and the nature of their proteins. Journ. Biol. Chem. 48 (1921) 433–439.

ILLUSTRATIONS

Plate 1

1 with adjacent small islands under its jurisdiction. (Enlarged from Coast and Geodetic Survey map of northwestern Palawan by Francisco Rafael.)

Plate 2

1. Contour and nature of the rocky cliffs of Bacuit.
2. Portion of a cliff in Bacuit showing cave openings. Note the small opening near center

Plate 3

1 and 2. Edible nests.
3. Nests in small bundles before shipment to Manila.

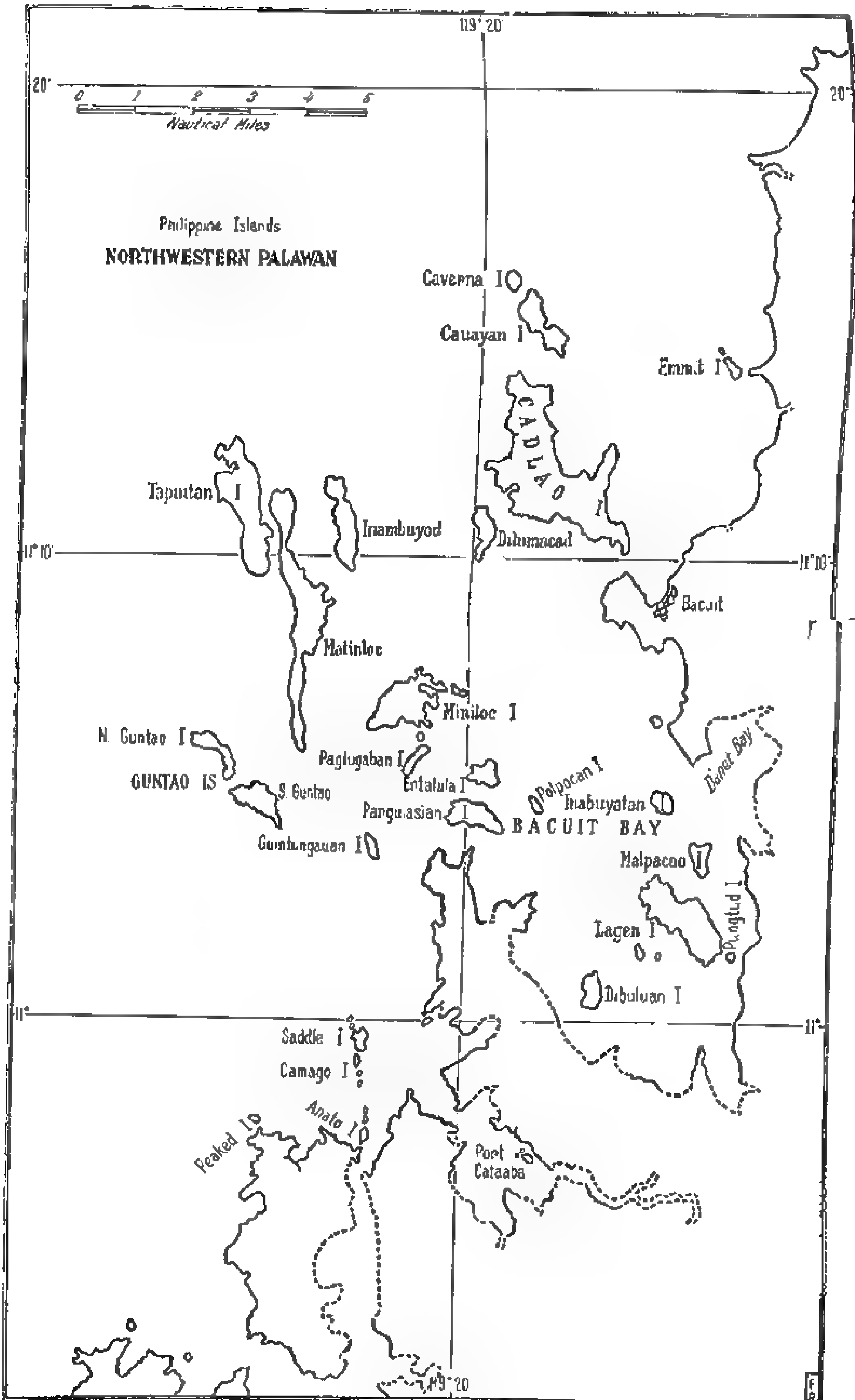
Philippine Islands
NORTHWESTERN PALAWAN
Nautical Miles
0 1 2 3 4 5
119° 20'
20'
11° 10'
11°
Caverna I
Cauayan I
Emmit I
CADLAO I
Tapiutan I
Inambuyod
Dilumacad
Bacuit
Matinloc
Miniloc I
N. Guntao I
GUNTAO IS
S. Guntao
Paglugaban I
Entalula I
Pangulasian I
Guintungauan I
Dipnet Bay
Polpocan I
Inabuyatan
BACUIT BAY
Malpacao I
Lagen I
Dibuluan I
Saddle I
Camago I
Anato I
Peaked I
Port Cataaba

PLATE 1

PLATE 2

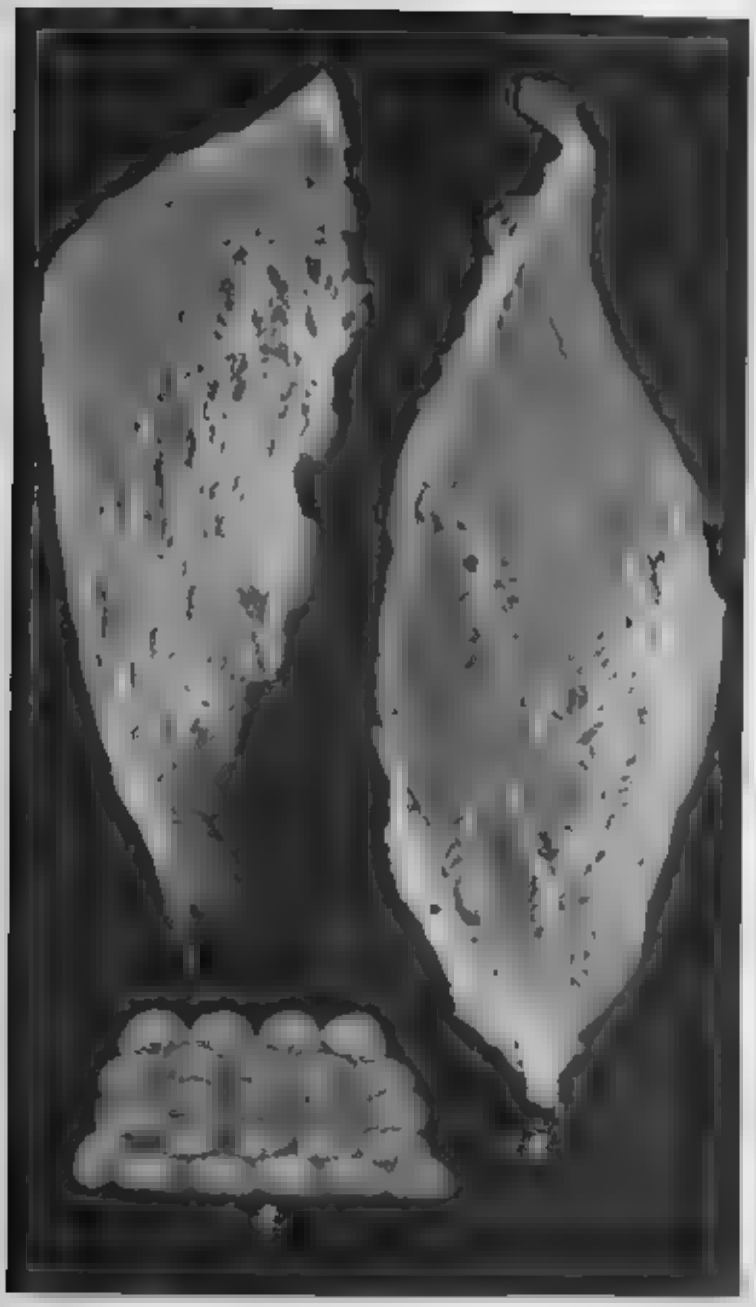

PLATE *

HETEROPHYIDIASIS, V[1]

OVA IN THE SPINAL CORD OF MAN

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TWO PLATES

Encouraged by our success in finding heterophyid ova associated with chronic specific lesions in the brain(2) identical with those reported by us(3) in the myocardium of persons the majority of whom died of cardiac failure, we extended our search for these eggs to the spinal cord in autopsy cases with evidence of heterophyid infestation. We have succeeded lately in finding heterophyid eggs in lesions in the spinal cord of a case of sudden death due to heart failure. In this case, adult *Heterophyes brevicaca* and *Monorchotrema taihokui* were recovered from the small intestine, and extensive lesions showing ova quite identical to the lesions we have already described in previous publications were observed in the myocardium. This report will deal chiefly with heterophyid infestation in the spinal cord, which, so far as we know, is being published for the first time.

REPORT OF CASE

B. Q., male Filipino, 44 years old, single, bricklayer, born in Batac, Ilocos Norte, but residing in Manila, was found dead in one of the streets of this city, May 18, 1936, and autopsied in the city morgue on the same day. No clinical data could be obtained from a brother who identified the cadaver. The following were the post-mortem findings: Hypertrophy and dilatation of the heart; sclerosis of coronary vessels; distention and congestion of lungs; congestion of liver, spleen, and kidneys; meningeal hemorrhage, basal extensive. Parasitological findings: Twenty-three adult specimens of *H. brevicaca* and 11 *M. taihokui* were recovered from the scrapings of the small intestine; sections of the myocardium taken from the apical region near the

[1] Aided by a special research grant from the Board of Regents, University of the Philippines.

interventricular septum revealed extensive lesions with eggs typical of cardiac heterophyidiasis; sections of the spinal cord in the lower and upper segments of the dorsal and lumbar cord respectively revealed islands of circumscribed, compact, specific reactive tissue and hæmorrhagic areas punctuated with eggs at various levels of the damaged cord. Extensive search for similar lesions in the brain was unsuccessful.

PATHOLOGICAL ANATOMY

Gross pathology.—On opening the spinal canal the dura mater from the level of the 5th dorsal to the 3rd lumbar segment was covered with a continuous adherent blood clot. The rest of the spinal cord appeared normal. The subdural space in this portion of the spinal cord was also filled with adherent blood clot, corresponding in extent to the hæmorrhage in the epidural space. The vessels of the arachnoid and pia maters in this region were very congested, and there was marked œdema on the left external surface of the intumescentia lumbalis. When the spinal cord proper was freed from the pia mater and from the septum anticus and the ligamentum denticulatum, there was noticed on the surface of the left lateral column in this region a dark-brown line of about 1½ mm maximum width, running parallel with the long axis of the cord, beginning at the level of the 7th dorsal segment where it was most conspicuous, and diminishing gradually posteriad until it became imperceptible at the level of the second lumbar. Macroscopic examination of transverse sections of the cord in this region revealed in the left lateral column a wedge-shaped, dark-brown lesion of about 1½ mm maximum breadth, with its base towards the left anterior horn of the gray matter which it slightly encroached upon in several levels, and its apex directed toward and reaching as far as the lateral margin. This lesion corresponded to the dark brown longitudinal line observed on the free surface of the left lateral column mentioned above.

Histopathology.—Examination of representative sections taken at different levels of the spinal cord, where the lesion is grossly apparent, reveals the following histological changes: The lesion is more prominent and extensive at the level of the 8th dorsal, maintaining the extent uniformly down to the 12th dorsal and from that point gradually diminishing until at the level of the first lumbar the lesion is reduced to one half. The involvement of the cord microscopically gradually disappears lower

down where the hæmorrhagic streak on the surface of the cord ends.

The lesions are moderately quite acute and, as in lesions reported previously from other organs, consist of marked capillary injection, perivascular and interstitial œdema, capillary thrombosis, multiple capillary hæmorrhages, degeneration and rupture of the nerve cells and tissues of the gray substance, and mechanical distortion of the neighboring tissues due to pressure of extravasated blood. The hæmorrhages, while confined to a great extent in the gray matter and axial in distribution, can be seen frequently to extend in small tracts across the white matter, sometimes reaching the periphery, either laterally involving the lateral column or dorsally the columns of Burdach and Goll.

Histologically the lesions are pronounced on the left half of the cord involving the entire gray matter and located mainly in the anterior horn, but also encroaching slightly on the posterior. A large zone of white matter laterally adjacent to the gray tissue is also affected. The portion of the cord showing these histological changes corresponds to the half of the cord which grossly shows the hæmorrhages on the surface.

The most prominent and extensive lesions are located in the portion of the gray matter. The hæmorrhagic processes have extensively destroyed more or less gray tissue in the immediate vicinity in an eruptive manner, creating in the section gaps or spaces partially or fully filled with granular tissue debris or spilled red blood and white cells. The destruction of tissue must have been due to both sudden loss of blood and mechanical pressure caused by the extravasated blood.

In the anterior horn the lesions dissect the nervous tissue up to near the surface of the cord. In the latter location where most of the eggs are found in the hæmorrhagic area the lesions are more cellular and compact with less admixture of red cells and destroyed tissue, and assume more the appearance of the typical specific reactive lesion observed in the brain(2) and heart,(3) and which is observed also in the heart of this case. In the same segments of the affected side of the cord, which show extensive hæmorrhages in the anterior horn, are found definitely circumscribed islands of compact specific reactive tissue located entirely in the white matter. Compared with the brain and cardiac lesions previously described, the specific tissue reaction observed here is rather loose, although proliferated en-

dothelial cells and histiocytes can be distinguished which, however, have not assumed the characteristic compactness of cellular arrangement shown by more chronic and older lesions.

The character of the specific tissue reaction in this case is that of a lesion of much more recent date. The most recent lesion here is more centrally located in the spinal gray tissue where purely hemorrhagic lesions can be found. These facts harmonize with our opinion that eggs imprisoned in the reactive tissues can best be seen in the older lesions, because they are caught in the compact tissue and therefore difficult to dislocate, whereas in the more recent, purely hemorrhagic, lesions, where the tissues are loose, the eggs are easily dislodged and lost during the technical preparation, unless they are present in exceptional abundance.

The eggs encountered in the lesion are few and far apart. In the examination of the whole series comprising the different blocks prepared from this case, there was no instance when more than one egg could be demonstrated in one serial plane. Judging from their size alone, two types of eggs can be demonstrated, a small one corresponding to *H. brevicæca* and a larger one corresponding to *M. tachekui*.

REMARKS

The present findings make the heterophyids the second group of flukes eggs of which have been definitely established as occurring in the spinal cord, since Ferguson (1913) has already encountered eggs of *Schistosoma hæmatobium* in the brain and spinal cord of a case that died of urinary schistosomiasis, and Mueller and Stender (1930) have reported a case of transverse myelitis involving eggs of *Schistosoma mansoni*.

In four of the five cases of cardiac failure reported by us in a previous publication,(3) in which physical examination could be made, the knee jerk was found absent. In a few cases were also observed numbness and formication in the extremities. The character and extent of the lesion in the spinal cord of the present case may reasonably be associated with loss of this function, especially if the lesion happens to be located in the right area and at the right level to interfere with the function of the different nerve tracts of the cord or with the function of the motor and sensory neurons. It would have been extremely interesting had the subject been observed before death, since, judging from the location, extent, and nature of this lesion, there

ought to be disturbances referable to this condition during life. Unfortunately the sudden and dramatic termination of the disease in the present case made it impossible to obtain data pertaining to this problem.

SUMMARY

The occurrence of heterophyid ova in the intumescentia lumbalis of the spinal cord, associated with lesions similar to those observed in the brain described in a previous publication by the same authors, is reported in this paper.

BIBLIOGRAPHY

1. Africa, C. M., W. de Leon, and E. Y. Garcia. Heterophydiasis, II: Ova in sclerosed mitral valves with other chronic lesions in the myocardium. Journ. Philp. Is. Med. Assoc. 15 (11) (1935) 583–592.
2. Africa, C. M., W. de Leon, and E. Y. Garcia. Heterophydiasis III: Ova associated with a fatal hemorrhage in the right basal ganglion of the brain. Journ. Philp. Is. Med. Assoc. 16 (1) (1936).
3. Africa, C. M., W. de Leon, and E. Y. Garcia. Heterophyidiasis IV: Lesions found in the myocardium of eleven infested hearts including three cases with valvular involvement. Philp. Journ. Pub. Health 3 (1-2) (1936).
4. Ferguson, H. Eggs of Shistosoma hematobium in brain and spinal cord; report of a case. Glasgow Med. Journ. 79 (1913).
5. Mueller, H. R., and A. Stender. Bilharziasis of the spinal cord simulating complete transverse myelitis: a case. Arch. Schiffs- u. Tropen-Hyg. 34 (October, 1930) 527–538.

ILLUSTRATIONS

PLATE 1

FIG. 1. Photomicrograph (low power) of a section of the spinal cord at the level of the 10th dorsal showing (*A*) extensive hemorrhages in the left anterior horn of the gray matter, and (*B*) a definitely circumscribed island of compact, specific, reactive tissue characteristic of heterophydiasis located in the lateral column of the white matter immediately adjacent to the anterior horn

2. Photomicrograph (high power) of a section of the spinal cord at the level of the first lumbar, showing an egg (marked *X*) in a hemorrhagic spot in white matter just outside the left anterior horn. Note the histiocytes and endothelial cells that have appeared on the scene, intermixed with red cells and a few leucocytes. If this lesion is traced serially upwards it will be found to be continuous with the island of compact, specific reactive tissue shown in Fig. 1 of this plate.

PLATE 2

FIG. 1. Water-color reproduction of the section that appears in Plate 1, fig. 2.

2. Water-color reproduction of a section of the spinal cord at the level of the 12th dorsal, showing islands of definitely circumscribed, compact, specific reactive tissue located in the lateral column of the white matter.

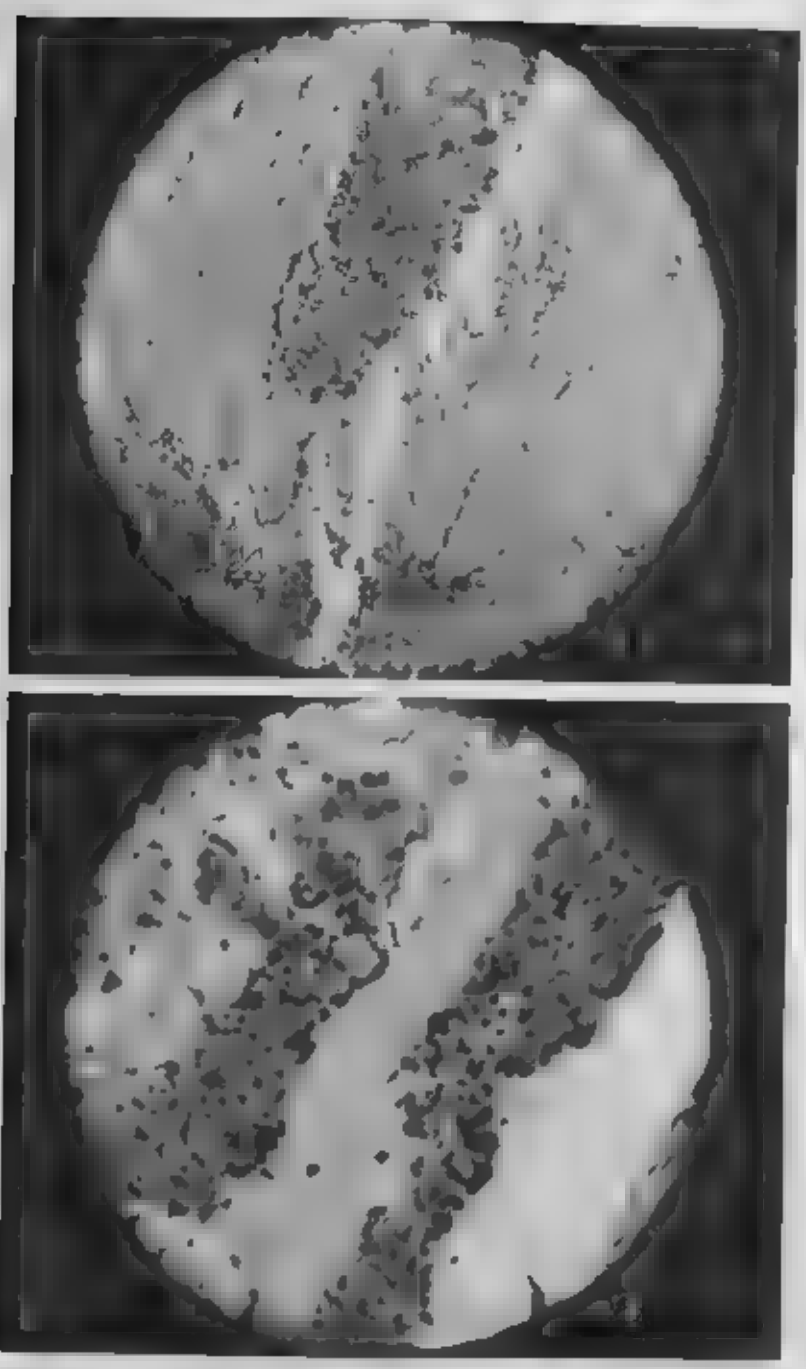

PLATE I

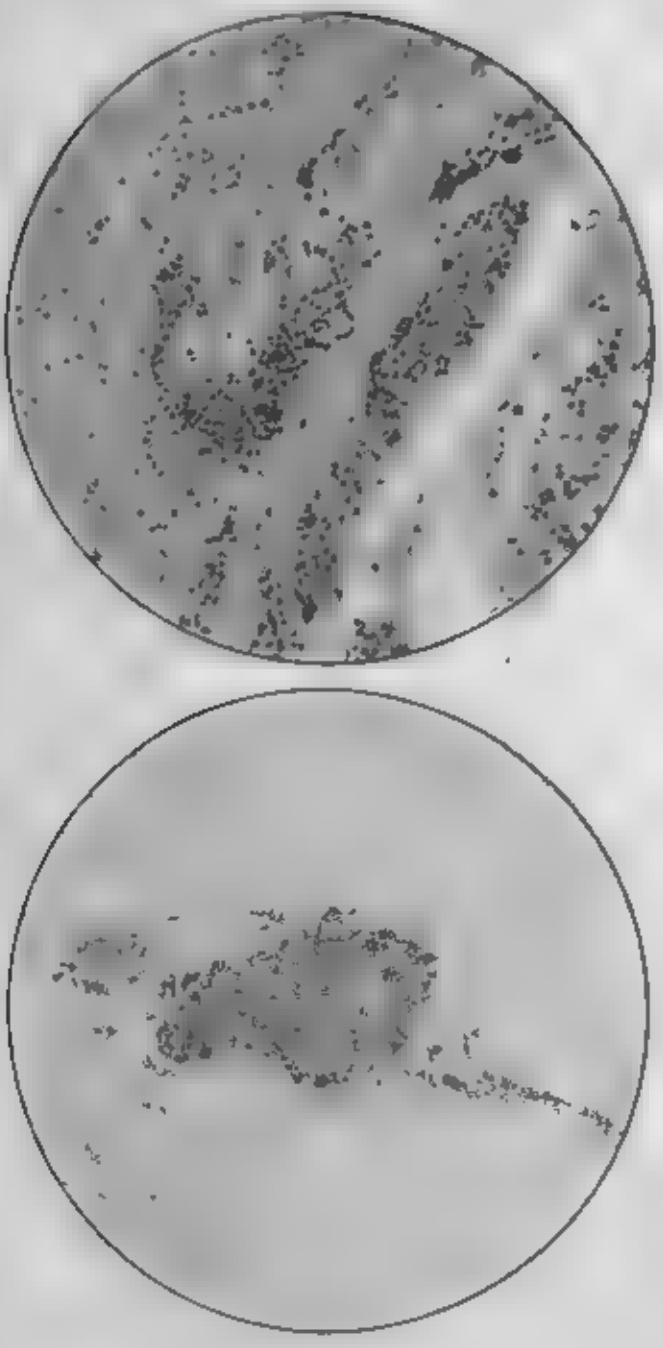

PLATE 2

BOOKS

Acknowledgment of all books received by the Philippine Journal of Science will be made in this column, from which a selection will be made for review.

RECEIVED

American medical association. Council on pharmacy and chemistry. Glandular physiology and therapy: a symposium prepared under the auspices of the Council on pharmacy and chemistry of the American medical association. Chicago, American medical association, 1935. 528 pp., illus. Price, $3.50.

American society for testing materials. Symposium on industrial fuels. Philadelphia, American society for testing materials, 1936. 70 pp., tables, diagrs. Price, $0.75.

Barber, G. O. School education in hygiene and sex; lectures given at Felsted school, by G. O. Barber with an introduction by the Rev. Julian Bickersteth and foreword by Sir Humphry Rolleston. Cambridge England, W. Heffer & Sons, 1936. 71 pp. fold. plate. Price, 2s., 6d.

Bary, P. Le neurotchoue. Preface de G. Urbain. 12th ed. Paris, Dunod, 1936. 246 pp., illus., tables, diagrs.

British plastics year book, 1936, the handbook and guide to the plastics industry. London, The Plastics press, ltd., 1936. 582 pp., illus. tables, diagrs. Price, 15s.

Chopra, R. N. A handbook of tropical therapeutics. Calcutta, Art press, 1936. 1743 pp. tables. Price, Rs 25.

Construction costs. New York, Engineering news-record, 1936. 128 pp., illus. tables, diagrs. Price, $1.

Cristol, Paul. Precis de chimie biologique medicale. Paris, Masson et cie, 1935. 638 pp., tables, diagrs. Price, 80 fr.

Dufato, Hannah. The glorious art of home cooking; how to plan, prepare, serve with recipes for every need. Chicago, Associated authors, 1935. 282 pp., front., illus., plate. Price, $2.75.

Guggenheim, L. K. Otosclerosis. St. Louis, Missouri, The author, 1935. 218 pp., illus., plates. Price, $6.

Hopkins, G. H. E. Mosquitoes of the Ethiopian region, I.—Larval bionomics of mosquitoes and taxonomy of culicine larvae. London, Printed by order of the trustees of the British museum, 1936. 250 pp., illus. Price, 15s.

Howard, J. H. Handbook for the amateur lapidary. Greenville, South Carolina, J. H. Howard, 1935. 140 pp., illus. Price, $2.

Iselsrud, Iver, R. J. Robinson, and T. G. Thompson. The distribution of phosphates in the sea water of the northeast Pacific. Seattle, The University of Washington, 1936. 34 pp., tables, diagrs., map. Price, paper, $0.25.

JENKIN, M. R. K. A text-book on forest management. London, Chapman and Hall, ltd., 1935. 156 pp., tables, diagr. Price, 10s. 6d.

JUDY, WILL. Dog encyclopedia. Chicago, Judy publishing co., 1935. 462 pp., illus. Price, $5.

KOENIG, Dr. E. International bibliography on the problems of blood transfusion and the theory of blood groups 1900-1933. Leningrad, Research institute of blood transfusion, 1935. 226 pp.

LARSON, T. H. Physicians and surgeons' text-book on endocrinology and ready reference therapy. Los Angeles, California, Chicago college of endocrinology, 1934. 870 pp., illus. Price, $10.

LOEPER, M. Thérapeutique médicale, IX maladies infect euses et parasitaires. Paris, Masson et cie, 1935. 414 pp., tables, diagrs. Price, 50 fr.

MACFADYEN, (MRS.) L. M. I. (DEAN). Alcyonaria (Stolonifera, alcyonacea, telestacea and gorgonacea) (British museum (Nat. Hist.) Great barrier expedition 1928-29. Scientific reports, v. 5, No. 2.] London, Print. by order of the trustees of the British museum, 1936. 53 pp., illus., plates. Price, $1.75.

The 1935 year book of the eye, ear, nose and throat. Chicago, The Year book publishers, 1935. 638 pp., illus. Price, $2.50.

PARMELEE, C. W. Clays and some other ceramic materials, pt. I. Ann Arbor Michigan, Edwards brothers, 1935. Illus., tables, diagrs.

PRATT, J. D. Gas defence. London, The British science guild, 1935. 18 pp. Price, paper, 1s.

RISEMAN, DAVID. The story of medicine in the middle ages. New York, P. B. Hoeber, 1936. 402 pp., front., illus. Price, $5.

SCHWARZ, E. W. K. Rayon and synthetic yarn handbook. New York, Rayon publishing corp., 1936. 568 pp., illus., tables, diagr. Price, $3.75.

SPERANSKY, A. D. A basis for the theory of medicine. Tr. and ed. by C. P. Dutt with the collaboration of A. A. Subkov. New York, International publishers, 1935. 417 pp., illus. tables, diagrs., plates. Price, $4.

WALKER, H. W. Wanderings among South Sea savages; and in Borneo and the Philippines. Rev. ed. London, H. F. & G. Witherby, ltd., 1935. 235 pp., illus., plates. Price, 7s. 6d.

WHITE, W. A. Twentieth century psychiatry; its contribution to man's knowledge of himself. New York, W. W. Norton & co., 1936. 198 pp. Price, $2.

WISHART, J., and H. G. SANDERS. Principles and practice of field experimentation. London, The Empire cotton growing corp., 1935. 100 pp., tables. Price, paper, 5s.

REVIEWS

Glandular Physiology and Therapy. A Symposium Prepared under the Auspices of the Council on Pharmacy and Chemistry of the American Medical Association. American Medical Association, Chicago, 1935. 528 pp. Price, $2.50.

This work consists of thirty-one articles, written by well-known authorities in the field of endocrinology, like Ascheim,

Zondek, and Novak, and representing the results of investigations conducted in renowned laboratories and hospitals, which have appeared previously in the Journal of the American Medical Association. It seems inconceivable that so much research information on endocrine physiology and treatment could be contained in so small a book. The contributors compiled data and selected only useful and well-tested experimental results. Successes and failures in hormone therapy are given due consideration.

The book is useful as a reference book for researchers and as a therapeutic guide to medical practitioners. A special chapter gives useful information about the physical and chemical properties as well as the therapeutic effects of various commercial gland preparations on the market. A subject index and a table of contents increase the usefulness of the book. It is rather unfortunate, however, that there are no illustrations or pictures of test subjects, for these would have made the book more interesting.—I. F.

Infra-red Irradiation By William Beaumont, with a foreword by Lord Horder. H. K. Lewis & Co., Ltd., London, 1936. 139 pp. Price, 6s. 6d.

This is a very interesting and instructive book. It emphasizes the place of infra-red irradiation in the field of therapeutics, and encourages further research for a broader application of the different rays of the electro-magnetic spectrum. The book will prove especially useful as a guide among general practitioners, and among gynecologists and obstetricians in particular.—A. V.

Birth Control: Its Use and Misuse. By Dorothy D Bromley. Harper Brothers, New York and London, 1934. 304 pp. Price, $2.50.

This well-written, readable, and straightforward book on a controversial subject—especially in our midst—is indeed fortunate and timely. It should be read by many, for it would surely open the minds of those who are prejudiced against the subject of controlled conception to a broader viewpoint and provide those who are sympathetic with a source of valuable information. The chapter on Spacing of Children gives valuable information that pediatricians and obstetricians ought to bear in mind if they are interested in the welfare of mothers and children. The good discussion on the treatment of sterility rounds out the book and makes it well-balanced.—U. D. M.

to the leaders of the nation interested in legislation governing the distribution of the public domain. The recommendations are timely suggestions to the Commonwealth Government and are strong arguments for establishing in the Philippines a definite land program.—H. S. S.

Parents and Sex Education for Parents of Young Children. By Benjamin C. Gruenberg. 3d rev. ed. The Viking Press, New York, 1932. 112 pp. Price, $1

This comprehensive little book is rich in suggestions to parents for handling the most delicate but important educational problem of young children. Frank and truthful instruction about sex facts is advocated. In the Philippines, where vulgarity among parents is not uncommon and sex knowledge among the older and younger generations of parents is practically negligible, this book should fill a great need. It should be read and reread by parents to enable them to help their growing children solve their new sex problems.

This book forms good supplementary reading to child study books for teachers, social workers, and those engaged in boys' and girls' work, and will enable them to coöperate with parents in the solution of their children's problems.—U. D. M.

Birth-control Methods (Conception, Abortion Sterilization) By Norman Haire. With a foreword by Aldous Huxley. George Allen & Unwin, Ltd., London, 1936. 192 pp., illus., plates. Price, $1.75.

Birth-control Methods, by Norman Haire, is a comprehensive little handbook on the subject. It discusses in a clear way all the known methods being used and their merits. It goes into detail about the use of silver rings as an intra-uterine contraceptive which is extensively used in Germany and England. This method has not been used to any extent in the United States. He claims it is less effective than the vaginal diaphragms and necessitates the service of an experienced gynecologist. However, it has the advantage of being less bothersome, which most women would rather prefer. The book is easy to read and would be handy for those who have little time to read more extensive treatises on the subject.—U. D. M.

The Human Foot, its Evolution, Physiology and Functional Disorders. By Dudley J. Morton. Columbia University Press, New York, 1935. 244 pp., plates. Price, $3.

Apparently this book would be most useful to orthopedic surgeons, although it would certainly be of great interest and value to physicians, anatomists, and anthropologists. What would

prove useful to the orthopedist is the comprehensive discussion of the various functional disorders of this part of the lower extremity of the body, as well as the means of their diagnosis and methods of treatment. But interesting to all will be the historical account of the evolution of the foot from a mere grasping appendage among the early ancestors of man to its present complex form.

The author deplores, and with reason, the commonly observed fact of the indifference of the public in general toward realizing the significance of foot disorders and the need of having them medically attended to. In so far as it will go in correcting this condition and reducing the number of those cases, which for lack of proper treatment give rise to disagreeable results, this book would be useful.—J. S.

Practical Clinical Psychiatry for Students and Practitioners. By Edward A. Strecker and Franklin G. Ebaugh. 4th ed. rewritten and enl. P. Blakiston's Son & Co. Inc., Philadelphia, 1935. 705 pp., illus. Price, $5.

The book is a concise presentation of the subject of psychiatry as it has been developed in the last three decades in America. The individual mental diseases, throughout the book, are considered as definite mental reactions, each mental reaction having been gradually generated and evolved by a definite set of psychobiological causations.

The psychobiological conception of mental disorders as originally announced by Adolf Meyer, professor of psychiatry of the Johns Hopkins Medical School, has been adhered to by the authors. What this conception on mental disorders is may be understood in the following paragraph, which is quoted from the first chapter of the book.

"The psychobiological conception begins by advancing the hypothesis that all of the activities of an individual should be studied in relation to each other in a particular setting. Where strictly organic lesions can be demonstrated these should be evaluated and treated in relation to the whole picture. Where psychogenic causes are the predominant features in the etiology these should be studied, beginning with the origin, if possible, and studying successive phases in development up to the present picture, since it is believed that mentation operates according to certain laws which are fixed as the laws of physics, and it fol-

lows that these laws operate alike for the mentally ill as for the mentally sound. No distinct identity is accorded to the so-called 'mind' since the concept of the latter was only artificially created to explain the 'mind-function' which depends upon inherited structures, and physiological processes like metabolism, oxygenation, etc., but both structure and physiological functions are modified from conception by the forces of environment through home, school, family and community, occupational, religious, recreational, economic and sex requirements. The 'minding-function' emerged as a new quality in the evolutionary process but is intimately related to all the biological processes which gave rise to it. Hence, everything that went into making a man is a part of his personality, and is consequently related to any disorder of that personality."

The psychobiological conception, therefore, urges us to maintain a pluralistic view regarding the etiology of mental disorders, and cautions us against the rigid belief in the inheritability of mental disease, inasmuch as the percentage of mental disease in tainted families is only slightly higher than in the general population.

Every mental disorder taken up in the book is presented, not by the old method of just narrating in a fixed and inviolable manner the characterization of the disease, but by the modern, more practical and more effective bed-side demonstration of classical cases. This method has the advantage over the older one in that every case is presented as a distinct individual experiment in nature—a distinct disease process with its peculiar etiology, symptomatology, pathology, course, and prognosis.

The book also brings information on the newly discovered therapeutic agents in the realm of mental diseases; and it emphasizes the fact that in the treatment of any disease it is not the disease process alone that is to be treated, but the whole individual, the entire personality, that presents the abnormal reaction. This brings to us the consideration of the fact that even in any somatic disease the constitutional personal element of the individual and his psyche play their parts in the disease picture; and that certain mental or emotional conflicts can produce definite physical disturbance or disfunction. In the chapter on psychopathological problems of childhood the writers have demonstrated among children cases of psychogenic constipation, enuresis, and tics.

The book, which has eleven chapters, is written in an easily understandable manner. It would be a good textbook in any medical school and should be read, not only by those who are interested in mental diseases, but also by the lay public because of the mental hygiene principles that are mentioned in it, especially in the last chapter.—T. J.

CONTENTS

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